THE

FOUNDRY TRADE JOURNAL

WITH WHICH IS INCORPORATED

THE IRON AND STEEL TRADES JOURNAL

VOL. 44. Thursday, April 2, 1931. No. 763.

PUBLISHED WEEKLY.

Subscription Terms: 15s. per annum.
Foreign and Colonial: 17s. 6d. per annum.
All Subscriptions are payable in advance.

All Communications to be addressed to the Editor, or to the Publisher, as the case may be, of

THE FOUNDRY TRADE JOURNAL,
49, WELLINGTON STREET, LONDON, W.C.2.

Telegraphic Address: "Zacatecas, Rand, London."
Telephone: Temple Bar 3951 (4 lines).

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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

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Forthcoming Events.

Institute of British Foundrymen.

APRIL 4.

Lancashire Branch:—Annual general meeting. "Jobbing Moulding and its Relation to the Engineer," Paper by S. Southcott.

APRIL 10.

Middlesbrough Branch:—Annual general meeting. "The Holley Permanent Mould," Cinematograph film, described by W. H. Bound.

APRIL 16.

London Branch:—Annual general meeting in London.

Look at Your Patterns.

When we started our campaign for "the same consideration and co-operation to be accorded to the founder as to the welder," we had but little hope that it would have exerted such a profound influence on the foundry industry as has recently been evinced. One outstanding research is the direct result of our effort, whilst even a foreign Government department has been influenced in the direction of closer co-operation between interested parties. We are thus encouraged to advise every founder to examine each casting he has to make from the ultimate-duty point of view, and translate into practice the following thoughts:—Craftsmanship is a tool to be eliminated where possible, as your competitors ruthlessly follow this tenet. Utilise light sections, suitably designed to give maximum strength, where strength is wanted. Imagine the casting made as a welding, and evolve a design from that particular angle. It will probably be unsuitable, but by combining this with the original design as given for the job as a casting, something of an excellent working compromise will be achieved. Bear in mind the possibility of welding on the pieces which may make the job awkward as a casting, and if this be acceptable and possible, then proceed to make a composition of iron or steel suitable for welding. In this connection, that particular place, where a "trimming" will be added by welding, must be exceptionally clean, because sand inclusions and the like are the enemies of the welder and will furnish him with arguments for deflecting the whole of the job to his bench.

It is to the steel founder that we look primarily for providing the engineer with "castings-weldings," as a sane combination of the two processes can obviously cut out the "donkey" work for the skilled men in both industries. In moulding it is the "fiddling little bits" that take up the skilled man's time, whilst for the welder it is the handling of large members that is the serious cost item. Thus it is obvious that complete co-operation between all parties is not merely desirable but essential if the best is to be obtained from the fabricating processes now available in engineering and metallurgy.

Foundry Text-Books.

We had occasion to review recently in our columns a new issue of a foundry text-book in somewhat severe terms, largely on account of the failure to take into account the remarkable change which has come over the founding industry in the past few years. The number of books that have been written on founding for the student in this country and in America is legion; they have been produced at intervals for almost a century. Yet very few, if any, can have been used seriously by the technical colleges and universities because founding as such has scarcely been recognised as a subject worthy of separate consideration in a text-book. Let us add that very few of these books have been worth that distinction. They have been used mostly, we should imagine, by engineering students requiring to obtain some knowledge of the principles of founding in default of practical experience, and having little opportunity of testing the knowledge they gained from them.

To-day the situation is vastly different. The attitude of the foundry craftsman and of the foundry executive to his job is vastly different. Knowledge has increased so much and the area of the trade has ramified so far that treatment in text-book form is imperative for those both inside and outside the trade.

The snag in the problem is that few men have such wide practical experience of the trade and such metallurgical knowledge that they could combine both in one book and use each side to illustrate and illuminate the other. This is seen at once if we examine the text-books previously produced. It is possible to say at once whether the author is a foundryman or a metallurgist. If the latter the practical side is a conventional re-hash in large measure of what has appeared in other books. If the former the book is apt to suffer from lack of descriptive skill and to be inadequately treated on the theoretical and metallurgical side. After all, life is very short to be an expert in both fields, and, badly as new text-books are needed, we imagine that foundry opinion will handle roughly any product that does not to-day give a practical illustration of the fact that founding is both an art and a science, needing the experience of the one and the knowledge of the other to blend into that combination which produces the perfect casting.

XUM

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Blast-Furnace Reactions.

To the Editor of The Foundry Trade Journal.

Sir,—The reading of Mr. Hurst's letter in your issue of March 19 drew my attention to Mr. J. E. Fletcher's Paper on "Blast-Furnace Reactions." It is feared that Mr. Fletcher revels in the study of Continental researches, and does not pay sufficient attention to the opinions of well-known men at home. In this respect Mr. Fletcher's Paper on "The Blast Furnace and Foundry Cupola" (Staffs I. & S. Inst., 1921-2) met with severe criticism and complete disagreement from well-known and experienced practical-technical blast-furnacemen who took part in the discussion.

The seven conclusions given by Mr. Hurst from American research under practical conditions are in keeping with general experience of practical men in this country, and also conform to theory. Slight variations are possible owing to variations in the working of the furnace.

I can hardly think, however, that Mr. Fletcher has correctly expressed himself when he uses the term "liquid sponge iron." This term contradicts itself. He further states "sponge iron was eutectic composition," and that "liquid carburised sponge iron is alloyed with Si, Mn and P in the furnace hearth; in contact with the slag Si, Mn and P are *obviously* reduced from the slag." Such statements are, I am afraid, entirely opposed to the elementary principles of smelting, which are that each metallic oxide has its minimum reduction temperature, and as soon as this is reached in contact with carbon, reduction takes place; this is a first principle. As the temperature increases as the charge passes down the stack, so does the rate of reduction increase, not only of Fe, but of Si, P and Mn also. C and S are absorbed, not reduced.

When the ore reaches the zone of minimum reduction, for a very short period of time small particles may be in the plastic or spongy state, but as sponge iron it would be physically impossible for it to travel down the furnace stack through the coke. As the charge drops and reaches the zones of higher temperatures, the spongy stage is passed and the *molten* drops of Fe, having absorbed their possible quota at that temperature of Si, P and Mn, trickle down through the smelting zone, passing from one piece of coke to the next lower, into the hearth or "well" of the blast furnace. S is no doubt absorbed by the slag, but the American results support what one would naturally expect, that no further material reduction of oxides takes place *in the hearth*, which is usually lower in temperature than the smelting zone just above the tuyeres.

Mr. Fletcher also refers to sponge iron made from fine ores by gaseous action *without coke*. There are several very different methods of doing this, one being a revolving cylinder, but there is no possible comparison with such sponge iron, for this is not a product of the blast furnace.

It may be of service to your readers to have a timely warning. A few years ago the work of one foreign investigator was given great prominence in this country, although some of his most important conclusions had been published years before by a Britisher. This gentleman about the time applied for a British patent, the subject-matter of which was already well known. This was quickly followed by another application intended to strengthen the first, but the claims put forward were impossible of realisation. Neither patent was granted, and both are officially void.—Yours, etc.,

E. Adamson.

Dore, near Sheffield,
March 25, 1931.

The Alloying of Iron in the Blast Furnace.

To the Editor of The Foundry Trade Journal.

Sir,—The point raised by Mr. J. E. Hurst, in his letter printed in your issue of March 19, is of interest and importance. Whilst it is commonly known amongst blast-furnacemen that reactions often occur between silicon, manganese and phosphorus with carbon in positions higher than the tuyere level, this fact does not disprove the writer's theory that the alloying results from contact between liquid carburised iron and the working slags.

The high velocity of the blast streams impinging upon the coke in front of the tuyeres is sufficient to drive liquid slag and metal well up the boshes, and a study of Kinney, Royster and Joseph's Paper will show that the outer annular half of the furnace is considerably hotter than the inner half or core of the furnace. Hot spots are often found at local positions many feet above the tuyeres, where both molten iron and slag have been driven.

When examining a blown-out furnace, it is not uncommon to find traces of gas wander-paths which have led to extensive erosion of the bosh lining, such as might be expected where metal and slag have been driven by the blast streams upwards along the lining. In the wide spaces between the tuyeres the spattering of the slag and metal streams is not likely to occur.

The writer does not assert that contact between the liquid-carburised iron and slag streams can only occur in the hearth of the furnace. Indeed, such contact must occur in a limited sense below the horizon of slag fusion, though the duration of such contact may only be short. The greatest likelihood of such slag and metal contact will be where these streams flow over the lower part of the boshes.

The close comparison between the results as estimated by the two-constituent method and those obtained in practice, as applied to every type of iron produced in British blast-furnace plants, is remarkable, and appears to furnish a useful and rational method for comparing the happenings in the lower portion of the blast furnace with the actual chemical and structural analysis of the pig-irons produced.

The fact that alloying of the iron can begin in isolated and irregular areas above the tuyeres in rapidly-driven hot-blast furnaces is a point in favour of slower smelting in smaller furnaces using cool and low-pressure blast, which conditions are favourable to a more uniform and steady distribution of the alloying actions in a less agitated hearth.

For the production of good foundry and forge irons, tranquility in the hearth of the blast furnace is an undoubted advantage and it can readily be understood that a good mixing of the constituents in a hearth is more likely to occur when the period between consecutive tappings is nearer twelve hours than six, the variation in the metal composition between one part of the pig bed and another being remarkably small.—Yours, etc.,

J. E. Fletcher.

11, St. James's Road,
Dudley.
March 25, 1931.

Notes from I.B.F. Branches.

West Riding of Yorkshire.—Mr. H. Sayers, Branch-President, and foundry manager of Messrs. Hill Bros., Leeds, and Mr. W. Parker, a Past-President of the Branch, and foundry manager at Messrs. Asquith, Limited, of Halifax, have both returned to business after their recent illnesses.

Members are visiting the works of Messrs. Slingsby & Company, Limited, of Woodhouse Road, Keighley, next Saturday.

Random Shots.

I have been presented with a red flamingo; I have twisted its neck two or three times; it has never made a sound. It was not a live bird and it is not a dead bird. In fact, it is not a bird at all, but a painted malleable casting in the form of a flamingo. Hence the twisted neck being suffered in silence. The Lake City Malleable Company, of Cleveland, Ohio, conceived the novel idea of distributing amongst prospective customers a number of these malleable-iron flamingoes (which, by the way, do duty as cigarette snuffers), with the invitation to test the malleability of the material by simple neck-twisting. A graphic but fiendishly-insidious method of advertising, for what buyer could resist such temptation? Salesmen are sometimes possessed of maddening persistence, but, alack! not even in Cleveland can one twist their necks without being chaired for it—electrically! The Lake City Malleable Company provides alternative necks.

* * *

Whilst touching upon the subject of birds, wasn't it Shelley who said of the skylark, "Bird thou never wert"? He thus provided a most apposite title for the following nonsense verse, from which the "lark" is not altogether missing:—

"Bird Thou Never Wert."

What a wonderful bird the frog are!
When he stand he sit, almost.
When he hop he fly, almost.
He ain't got no sense, hardly.
He ain't got no tail hardly, either,
When he sit he sit on what he ain't got, almost.

For the foregoing, "Marksman" confesses indebtedness to the foundry industry's "Malcolm Campbell."

* * *

A morning newspaper poses the startling question: "Does Manganese Make Good Mothers?" An American authority on nutrition has suggested that "mother love may be due to a microscopic fraction of manganese in food." His experiments consisted of feeding rats with a manganese-free diet and noting that thereby the normal maternal affection was entirely destroyed; from which he advances the theory that our most highly-valued social feelings may be governed by food constituents. That is nothing new. A man who has dined on lobster, caviare, oysters and a magnum of champagne cannot be expected to awake the next morning imbued with humanity's noblest impulses and emotions!

* * *

Song of the Foundry-Equipment Sellers.

In an old-fashioned town, in an old-fashioned street,
In an old-fashioned foundry our travellers meet
An old-fashioned foreman with old-fashioned theories,
Whose old-fashioned beverage old-fashioned beer is.
In his old-fashioned office, in an old-fashioned way,
He sings as he works this old-fashioned lay:

"I've worked this 'ere foundry since I were a lad,
An' me castings be good, though me practice be bad.
Ould-fashioned they calls me, ould-fashioned I am,
'Cause I won't buy their core-oils or things that jar-ram.
O, I've worked this 'ere foundry, it's worked very well,
And they and their samples can all go to—sell!"

Marksman.

Making Pipes in Green Sand.

The Wales and Monmouth Branch of the Institute of British Foundrymen held a meeting at the Merchant Venturers' Technical College on February 28, when an interesting talk on "Making Pipes in Green Sand" was initiated by Mr. Jackson, of Exeter.

Mr. Jackson said that cast iron was probably used more for the manufacture of pipes than anything else, and there were very few foundries which were not called upon at some time or other to make them. There was a wide range of types of pipes, which could not be dealt with at one meeting, and so reference was only made to special and standard connections. The first essential to a pipe-founding works was a good stock of patterns, bends and branches to different angles. Unless a good system was adopted when preparing such patterns, a serious amount of capital would be sunk, from which there was not likely to be much return.

Interchangeability of Patterns.

In the majority of cases this expenditure could be saved by making patterns which were interchangeable, and in this connection shell patterns were very valuable, the joints being formed on the parting line and made to leave their own cores, the mould and core being made in green sand. This method was used years ago, but did not appear to be widely utilised in the making of large connections. It will be argued that it paid to have one-piece patterns for small standard pipes, and this was the case, especially if mounted on a machine and the bends were

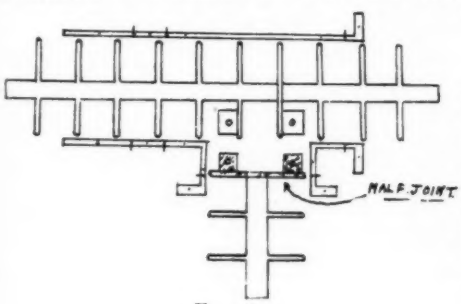


Fig. 1.

slung two on a core, but for small numbers and large pipes, shell patterns were by far the best, both as regards their cheapness and time of moulding.

These shell patterns are first struck up in plaster allowing for three contractions: one for the master pattern (advisable in case of breakages), one for the patterns and one for the finished pipe. The straight pieces are made in different lengths, as illustrated in Figs. 1 and 2, where the tee and bend patterns are also to be seen. The only patterns which were not struck in plaster were the 30-in. sockets and flanges which were struck direct in loam and split, one splitting plate being fastened on each half of the patterns. By making the straight pieces in different lengths one was enabled to make short, as well as long, pipes. It was advisable to have all ends of patterns machined if possible, as it saved a lot of time in squaring up. Having had the patterns dowelled, they were then ready for the foundry.

Straight Pipes.

Before a pipe could be started, a core iron was necessary. This was done by levelling a bed in the floor and stamping the top-half patterns in the sand, leaving an impression of the pipe required. To form the core iron, wings were made, 1 in. smaller in dia. than the internal diameter of the pipe it was being made for. The wings were spaced about 6 in. apart and joined by a dog bar cut up through the centre. The iron being ready, the bottom-half patterns were set in the floor and rammed up and joints made. The core iron was then lowered in position, bearings being put at the ends of the pipe. The bottom of the core was rammed and a vent pipe placed on top. The top-half patterns were placed on and rammed one by one until the pipe was complete. The joints were made and the top box lowered on. These boxes were made to take tee pipes, it being easy to stop off the

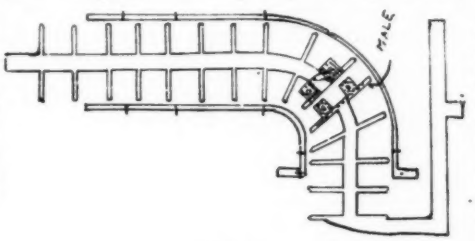


Fig. 2.

unwanted end in the case of a bend pipe being required.

The top box was rammed up, staked and the top patterns fastened up, after which the top was lifted and put on rests. The bottom patterns were rapped at the joint and the core lifted out and the whole mould finished, runners being cut in at the spigot and in under the core. The mould was then assembled and runner cup made up, the core iron being packed with a wedge between iron and box-part. The mould was then ready to cast.

Bend Pipes.

Making a bend pipe was a different problem altogether. The core iron for a bend was made, with a strong arm on the end of the bend (Fig. 2). This arm both balanced the core when lifted and stopped it from sagging when lowered back again, besides doing away with chaplets or studs in the smaller pipes. The same top box was used for bends as was used for the tees, the unwanted end being stopped off. These methods were satisfactory for pipes up to 12 in. in dia., but above this size it became an expensive matter to make a core iron for every pipe required. To overcome this difficulty, the tee irons are jointed as shown in Fig. 1, and Fig. 2 shows how the bend irons are jointed. By jointing, the core irons can be used over and over again.

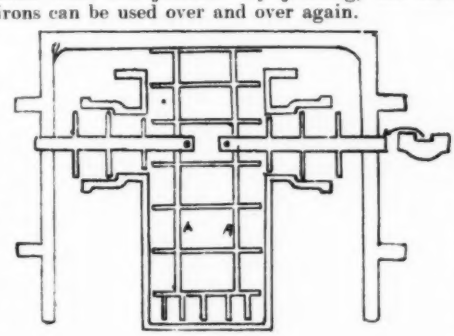


Fig. 3.

The jointing of the bend core iron weakened them, but not so much that they could not be lifted from the mould and be replaced, but to hold them down whilst being cast was another matter. This could be overcome by ramming a brick on top of the core iron at the bend and by using a stud to make sure it did not lift. When the pipe was cast the brick collapsed and allowed the pipe to contract normally. By these methods, bends and tees up to 30 in. dia. could be made in green sand. Such pipes were run under the core, at the spigot end, if any; if not, at the flange end. To stop the core from scabbing, where the metal entered the mould, the joint was made ⅛ in. under the level of the pattern. This gave the core a good clearance.

All floor sand was used for the top half of all cores, irrespective of size. With cores up to 8 in. dia. the top half should not be polished with plumbago. Over 8 in. dia. all should be polished. The most difficult connection to make in green sand was a syphon pot. These pots were made regularly up to 24 in. dia., and it might be helpful to describe the methods adopted in making a pot of this size with 12-in. branches.

Making Syphon Pots.

The core iron was made using wings which were hollowed on the tops to take unnecessary weight out of the iron and also to form a trough for the vent coke. Two dog bars were used in making the body iron, as would be seen in Fig. 3, which also showed the different sections of patterns used and how the branch irons were fastened to the body iron. To start the actual mould, a pit was dug in the floor and a plate lowered in large enough to take the top box to be used. Weights and hook bolts were set (A and B, Fig. 4). A coke bed was put in and covered lightly with straw, the gas being brought off at the joint by means of a pipe (Fig. 5). A bed was levelled and patterns set in and rammed to within 8 in. from the joint, when the branch patterns were set. Before proceeding the mould was vented down to the coke bed, the vents being covered with a stream of coke, outlets for this being brought off at the joints. The remainder was then rammed up and the core iron lowered in. After the arms had been

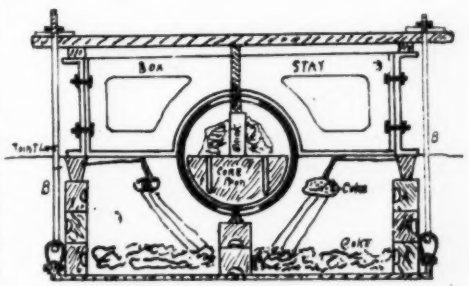


Fig. 4.

rammed the iron was staked, hoisted out and put on supports to be clay-washed.

Moulding Details.

The joints were made and the core iron lowered back. The bottom half of the core was then rammed up and a stream of coke placed on, allowing about 5 in. of sand between the coke and the top patterns. A brick was placed in position 1 ft. from the bottom of the casting to take a stud. The top-half patterns were put on one by one until the top was complete. The joints were made and the box-part sections taken out. These consisted of two sides, two ends, and the bars made to suit the job. These were bolted together and rammed. The top-half patterns were fastened up and the box staked and lifted off and finished, risers being put on the sockets, flange and bottom of the pot. The core was lifted out and finished, plumbago being well rubbed in.

The bottom patterns were drawn out and the bottom finished, the runners being cut 3 in. by ½ in. in section. The core was lowered back and the stud placed in position and the top lowered on. The mould was fastened down by means of hook bolts and girders as shown in Fig. 4.

Fig. 4 also shows the method used to hold the core in position with the studs. Fig. 5 shows the section through the pipe at the branches. Fig. 6 shows a plain bend made up of interchangeable parts, marked ABC with joints at XX and YY. To obtain a pattern to the reverse hand, one alters the position of A to that of C and C to that of A.

XUM

A further development of this principle is shown in Fig. 7, which shows a pattern of a pipe made up of seven pieces and with the joints properly arranged. No less than 16 patterns of pipe bends to different angles may be obtained from this. The pieces are marked A.B.E.E^a.F.G.H. The piece H is cut to form an angle of 45 deg. at the centre of its curve, G at an angle of 22½ deg., F to an angle of 11¼ deg., E to an angle of 5⅝ deg. and E^a to an

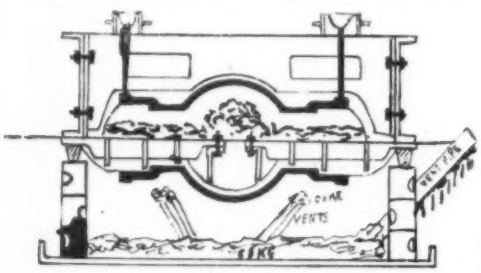


Fig. 5.

angle of 5⅝ deg. The following are various combinations obtainable with these:—

A.H.G.F.E.E.B.	... ...	90 deg.
A.H.G.F.E.B.	... ...	95⅝ ,,
A.H.G.F.B.	... ...	101¼ ,,
A.H.G.B.	... ...	106⅞ ,,
A.H.F.E.B.	... ...	112½ ,,
A.H.F.B.	... ...	118½ ,,
A.H.E.B.	... ...	129⅜ ,,
A.H.B.	... ...	135 ,,
A.G.F.E.B.	... ...	140 ,,
A.G.F.B.	... ...	146¼ ,,
A.G.E.B.	... ...	151⅞ ,,
A.G.B.	... ...	157½ ,,
A.F.E.B.	... ...	163¼ ,,
A.F.B.	... ...	168⅞ ,,
A.E.B.	... ...	174⅝ ,,

From this it will be seen there is practically an unlimited scope for this method of pipe-making.

DISCUSSION.

Mr. Howe asked what method was adopted for keeping the patterns straight.

Mr. Jackson replied that so long as the patterns came face to face there was no trouble. These were checked with a straight edge. With the master pattern there was little in the three contractions. The master patterns were made in plaster and to get inside the pipe a block was struck up exactly the size of half of the pipe. The plaster was allowed to harden and was eventually varnished and smeared with oil. A good strickle was required. This half-pipe

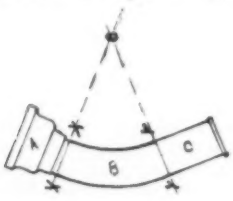


Fig. 6.

section was built up with plaster, and when hard it could be cut in the lengths required. The coat of oil would leave the pattern cleanly, whilst linseed oil was used for preference.

Mr. R. J. Richardson asked whether there were serious breakages with the master patterns.

Mr. Jackson replied that it was usual to give the pattern to the best man in the shop, for unless it was carefully handled it would be broken.

Mr. C. A. Howe asked how long it would take to make a pipe as compared with using a wood pattern in loam.

Mr. Jackson said a shell pattern of a 24-in. pipe, 5 ft. to 6 ft. long, would take two men 2½ days. This weighed from 13 cwts. to 15 cwts. He did not use bottom boxes, but put these moulds in the floor. They used black sand for the top half of the mould and had very few scabs, although this was possible through careless ramming.

Mr. Richardson asked what was the principal advantage; was it a question of production or cheapness? Supposing one had an order for 2,000 pipes, how would these be made?

Mr. Jackson replied that if he had a machine he would use it, but there was an advantage in

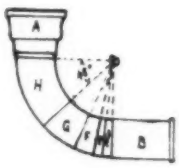


Fig. 7.

both production and cost in the method he had endeavoured to describe. With a stock of shell patterns it might be possible to get a bastard bend for which one had no pattern. Then a template could be made and the bends matched as near as possible. The core iron is made to the template. When the finishing pattern was made it might stick out a trifle, and then this would be left to the moulder to remedy. This meant less work than knocking out in the pattern.

In finally thanking Mr. Jackson, Mr. Richardson said he thought it was generally agreed there was a great advantage in the method advocated, but they were not agreed as to the cost of production.

Burnley Section Selects Officers.

The annual general meeting of the Burnley Section of the Institute of British Foundrymen was held on March 10 at the Municipal Technical College, Ormerod Road, Burnley. Mr. Alec Jackson was re-elected President for the ensuing year. Other officers were:—Vice-Presidents, Messrs. James Taylor and Fred Harris; hon. secretary, Mr. J. Pell; members of Council, Messrs. C. Tate, J. Lowe, L. Wharton, J. Cross, J. Richardson, W. Barnes, W. Howarth, J. Hogg and G. Barnes.

After the annual meeting, Mr. W. Barnes opened a discussion and stressed the need for more practical Papers and the arrangement of suitable facilities for their being discussed more fully. Mr. John Jackson, Mr. J. Hogg, Mr. W. Howarth and Mr. Harper supported Mr. Barnes' proposal, and it was decided to instruct the Branch Council to make suitable arrangements for next session.

Mr. F. A. Harper (Middlesbrough) agreed that there might be some little truth in Mr. Barnes' remarks. It had, however, only been his privilege to visit the Burnley Branch once before, and, strange to say, on that occasion the Paper, presented by Mr. Fred Harris, was exactly on the lines advocated by Mr. Barnes. Other Branches might complain of lack of interest from the ordinary working moulder, but Burnley at least had endeavoured to attract them by including several Papers of interest to all manner of foundrymen.

True, the meetings might be given a more informal air, and probably a meeting devoted to actual moulding topics might encourage a five-minute speech from the most reticent of men. He would suggest the subject as "My most difficult moulding job," and, human nature being what it is, surely each member present would endeavour to enlarge upon the previous speaker's experience. Having been induced into making his maiden speech, the most uninterested moulder might well become a most enthusiastic member.

Lecturers, too, might simplify their Papers, or at least not go out of their way to introduce technicalities.

The New International Association for Testing Materials.

SEPTEMBER CONGRESS AT ZURICH.

The first congress of the New International Association for Testing Materials (N.I.A.T.M.) will be held from September 6 to 12, 1931, in the buildings of the Swiss Federal Polytechnicum, Zurich. The following is the list of subjects for discussion:—

Group A.—Metals.—(Chairman: Dr. W. Rosenhain, D.Sc., F.R.S., National Physical Laboratory, Teddington, England.)—(1) Cast Iron; (2) Strength of Metals at High Temperatures; (3) Fatigue; (4) Notch Bar Impact Test, and (5) Progress of Metallography.

Group B.—Non-Metallic Inorganic Materials.

Group C.—Organic Materials.

Group D.—Questions of General Importance.—(Chairman: Prof. W. von Möllendorf, Staatliches Materialprüfungsamt, Berlin-Dahlem, Germany.)—(1) Fundamental and Test Relations between Elasticity and Plasticity, Toughness and Brittleness; (2) Determination of Grain Size in Loose Materials, and (3) Calibration and Accuracy of Testing Machines.

General Information.

Members affiliated to the British branch should send in applications for the advance proofs and for any other information to the Secretary-Treasurer of the N.I.A.T.M., 28, Victoria Street, London, S.W.1. The registration fees for the congress are as follow: For each member attending the congress, 12s. 6d.; for each lady accompanying them, 8s. 6d., and for each non-member, £1 5s.

Messrs. Thos. Cook & Son, Limited, Berkeley Street, London, W.1, are prepared to supply travel tickets to Zurich and return and to secure hotel accommodation for intending participants in the congress at Zurich at an inclusive price. The period of validity of the tickets is 33 days. The General Secretary of the N.I.A.T.M. is in negotiation with the Office Nationale du Tourisme in Switzerland in order to ensure the comfort and convenience of visiting members during their stay in Switzerland.

The Autumn Meeting of the Institute of Metals will also take place at Zurich in the week commencing Sunday, September 13, immediately following the congress of the N.I.A.T.M.

Contracts Open.

Bridlington, April 4.—64 tons of cast-iron water mains, for the Town Council. Mr. W. Thompson, waterworks engineer, Marton Road, Bridlington.

Conway, April 7.—1,650 yds. of cast-iron S. and F. water pipes, for the Conway and Colwyn Bay Joint Water Board. Mr. C. F. Farrington, engineer to the Board, Trinity Square, Llandudno. (Fee £5 5s., returnable.)

Dunfermline, April 3.—1,000 yds. of cast-iron pipes, for the Town Council. Messrs. Crouch & Hogg, engineers, 17, Lynedoch Street, Glasgow, C.3. (Fee £1 1s., returnable.)

Oldham, April 7.—Cast-iron pipes and specials, steel pipes, lead wool or other jointing material, pig lead and valves, for the Corporation. Mr. E. Parry, commercial manager, Gasworks, Greaves Street, Oldham.

Singapore, April 30.—Two small pumping sets and two centrifugal pumps and motors, for the Singapore Municipality. The Department of Overseas Trade. (Reference G.X. 10,192.)

Aluminium paint has been found to be very efficient for coating wooden patterns. Splitting is checked due to its waterproof properties, and it offers excellent resistance to noxious gases. It has the advantage of being non-poisonous, and patterns so coated are easy to withdraw from moulds.

The Foundries of Messrs. Crane-Bennett, Limited.

A visit to the extensive factories of Messrs. Crane-Bennett, Limited, Nacton Works, Ipswich, whose head office is situated in Leman Street, London, E.1, with sales offices and warehouses in the largest cities in the country, emphasises the importance of co-operating technical experience with well-balanced mechanisation to ensure success.

The site, which at present is only partly built upon, is connected by a private siding to the London & North Eastern Railway about three miles from Ipswich. About 500 people are now employed. The present buildings comprise two foundries, one making black-heart castings for malleable pipe fittings, and the other grey-iron castings for radiators and boilers for central heating. These two foundries have a number of features common to both. For instance, in the matter of external transport, the same is used for both foundries. The pig-iron arriving at the sidings is unloaded by a magnet operated from a Morris overhead electric travelling crane running on an 80-ft. span. This fills large storage hoppers, from which the iron is withdrawn at the base and loaded into wheeled skips resting on Avery automatic open-dial weighing machines. The coke consignments are handled by a grab bucket which fills similar bunkers, but provision is made by means of a grid for removing the fines. The weighed wheeled skips pass the storage bunkers from right to left and pass beneath the cupola stage. Here they are elevated by a crane through the stage and, on reaching the cupola charging door, the skip is racked out and automatically discharged into the furnace. The skip is then racked in, lowered to ground level and sent round to the storage bins, having completed the proper circuit. Thus human hands have only touched the pig-iron and coke once between arrival and charging, which we consider to be the irreducible minimum commensurate with proper control.

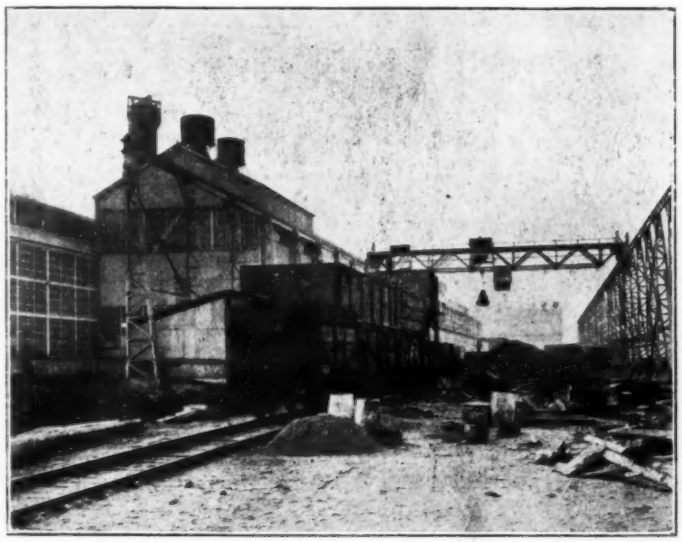


Fig. 1.—The Stockyard, Messrs. Crane-Bennett, Limited, Nacton Works, Ipswich.

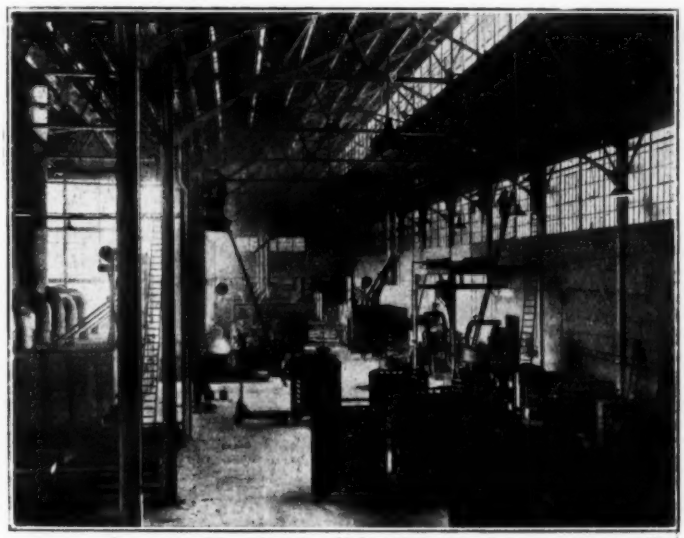


Fig. 2.—Part of the Core Shop, Messrs. Crane-Bennett, Limited, Ipswich.

Core Department.

Another department which is common to both foundries is the core-room building. Cores are made from dried silica sand. The sand is stored in a reinforced concrete building 320 ft. long by 20 ft. wide by 15 ft. high, which is capable of holding 4,000 tons. This sand is handled by overhead crane and discharged through the special sliding roof of the sand store, thereby eliminating human element on this work. The cores are made in master metal core boxes and transferred to metal shells of the exact contour for drying. We must say that we like the term "shell," and in future we shall use this word in place of "dryers" or "carriers." The only objection is that it translates rather badly into foreign languages, and to the uninitiated abroad may read "chill."

After drying, the core sand is treated in two August-Simpson bucket-loaded mixers having 6-ft. dia. pans. Containers of known cubic capacity are used and a regular ratio of "Glyso" is maintained. This is gained by experience for their particular type of work. The drying of the cores is effected (for malleable) in three batteries of oil-fired shelf-type stoves. For the larger cores racks are used, whilst for the radiator foundry special racks are employed, and, after drying, each core is separately dressed and gauged, placed carefully in wooden-wheeled containers and transferred to the foundry. All the ovens and machinery are painted with aluminium—a refinement well worth emulation by every foundry in the land. At this point it can also be mentioned that these factories are adopting the practice of painting, with white paint, the whole of the interiors of the plant. This will be perpetual work, and the results, both from the general point of good housekeeping and the improved general atmosphere created, should stand as an example to other factories and shops in the country.

Malleable-Foundry Melting Plant.

As Mr. H. H. Shepherd recently indicated in his Paper, "Cupola Malleable Cast Iron," presented before the London Branch of the Institute of British Foundrymen and published in our issues of January 29, February 5 and 12, the melting plant has recently been changed. Before the alteration a 54-in. Green cupola was in commission and is still retained as a stand-by. Now a 60-in. Poumay by the Constructional Engineering Company is in commission. It is fan-blown from a Keith-Blackman fan actuated by a 35-h.p. B.T.-H. motor. Welsh navigation coke is used in the ratio of 7 to 1, including the bed. It is too early to report on the economic application of the Poumay system to black-heart practice, but it appears that whilst initially the cost is much the same, advantages are being disclosed in the annealing and casting properties. In both foundries a kettle-spout receiving ladle is filled, but in the new radiator foundry (it had only been operating a fortnight at the time of our visit) the casting ladles are filled by operating a hand-wheel, whilst in the malleable foundry this is effected by a man seated some 10 ft. above the floor on the level of the mono-rails. This practice, however, is being altered to bring it into line with the latest method in operation in the radiator foundry. We prefer the newer system, as the operator is more mobile and can be utilised for other jobs when the demand for metal slackens. The system of mono-rails covers the whole foundry, and the provision of complete outward and return circuits has assured a smoothness of casting operations which should commend itself whole-heartedly as a cheap and sane method of tackling continuous-production foundry problems.

Moulding Equipment.

Much of the repetition moulding is carried out by combining very effectively eight rotating tables with sixteen moulding machines. These moulding machines, which have been designed and manufactured by the firm's associated companies, are of the air-press type furnished with vibrators for easy stripping. These vibrators come into action automatically, immediately the pattern is begun to be stripped. As stated, there are two machines for each table; each machine makes a complete mould. These are assembled in snap flasks, placed on the table, the snap flask is removed and replaced by a slip flask. These tables resemble the merry-go-round of the fair-ground, and, being carried on ball bearings, rotate with a touch of the hand. For their operation they require two men, one to each moulding machine, and one man for two machines for assembling the moulds, stripping and shifting the tackle. The complete battery of eight demands the services of two teemers. In passing it should be stated that the poured mould is dumped on to an apron conveyor running centrally at floor level between the round-abouts and extended to cover the whole length of the foundry. However, we will return to this later.

Supplementing the production of the round-about units are 12 other machines of similar type, but carrying larger tables. It was here we noticed some heavy-section flange castings being made which would test the skill of most malleable founders. As the section is about 3 in., chills have to be resorted to.

Sand Preparation and Distribution.

As indicated, an apron conveyor has been installed at floor level running centrally along the

whole length of the foundry, and on to this are charged sand and hard castings. This conveyor rises at the round-about end of the foundry and discharges its load on to an inclined grid. The sand falls through into a hopper, whilst the castings slide down the grid and are transferred by a fork into metal containers according to size for transference to the adjoining shop for further treatment. The sand from the hopper is elevated and passed through a rotating screen, which automatically rejects any pieces of metal and the like. On leaving the screen the sand is passed along a band conveyor, where the stream is damped by a water spray which is manually controlled according to the amount passing through the system. The band loads the sand into a screw-paddle mixer, which discharges the sand on to another conveyor running at right angles along the whole length of the shop in order to effect proper cooling. Here it discharges into an aerator or revivifier, which is of the type that throws the sand at high speed through a nest of suspended rods. On leaving this machine the sand is divided into two parts, one conveyor of the scraper type taking one part back along the shop beneath the cooling conveyor and distributing it to the hoppers placed above each moulding machine, whilst the second transfers sand to the opposite side and the shop and performs a similar function.

For the malleable foundry the "system" sand is used only for "backing" purposes, and facing sand is prepared in a bucket-loaded August-Simpson intensified sand mixer.

Hand Barrelling.

The steel containers filled with the hard castings are pushed but a few yards, where the contents are charged into the rumbling barrels together with a quantity of stars. The rumbling barrels are of large capacity and an adequate number to take care of the full output of the malleable foundry. The dust is extracted by a cyclone from a duct common to the whole battery. The barrelled castings are filled into trays, which are placed on the left-hand side of the sorting and inspecting benches. The benches are raised from the floor, and, at the right-hand side, conveniently situated, are the annealing pots, which, by the way, are cast in the malleable foundry from early and late taps. The pots are handled by air hoists in a narrow shop between the sorting benches and the annealing furnaces. The four high stacks of pots are transferred by a loading truck carrying prongs which pass beneath the base, ready to be placed in annealing ovens.

Annealing.

The battery of ovens consists of three 11-ft. and two 20-ft. oil-fired furnaces. Whereas originally these furnaces were sufficient to cope with the output from the foundry, very large extensions are at present under way, so that by the end of the year the five furnaces will have been increased to full length. By this extensive increase in the size of the annealing furnaces their capacity will be ample to keep pace not only with present demand but also future increases. According to the size of the ovens, the necessary number of burners are introduced through the roof, whilst the flues are conveniently placed along the floor so as not to foul the pots. In the smaller furnace between 450 and 500 galls. of crude oil are used to anneal 10 tons of castings, whilst in the larger furnaces 20 tons are malleablised with 750 to 850 galls. Mechanical control is effected by the operation of a number of dampers, whilst the use of both thermocouples and optical thermometers ensures the maintenance of predetermined temperatures within very narrow limits.

It is pleasing to note that under the conditions operating at Nacton Works, there is virtually no erosion of the roof and side-wall bricks by the action of the fuel oil, this point having received the very careful attention of their engineers. The doors of the oven have received special attention by way of lagging, and the test of touching with the hand during full heat impresses one as to its effectiveness.

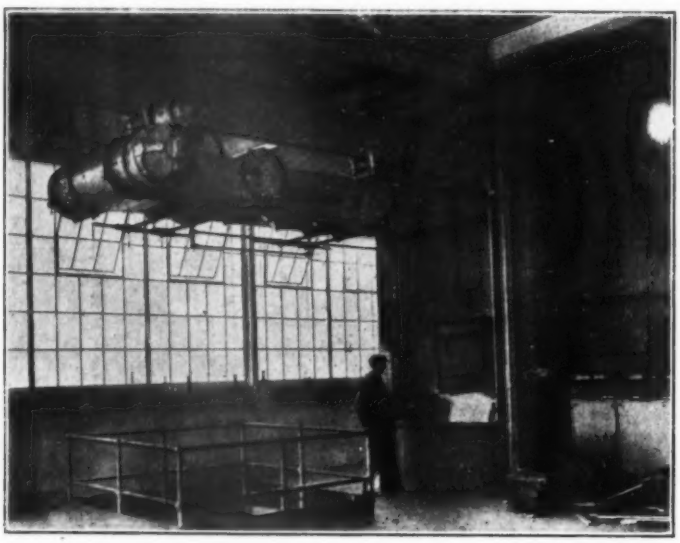


Fig. 3.—The Cupola-charging Device, Messrs. Crane-Bennett, Limited.

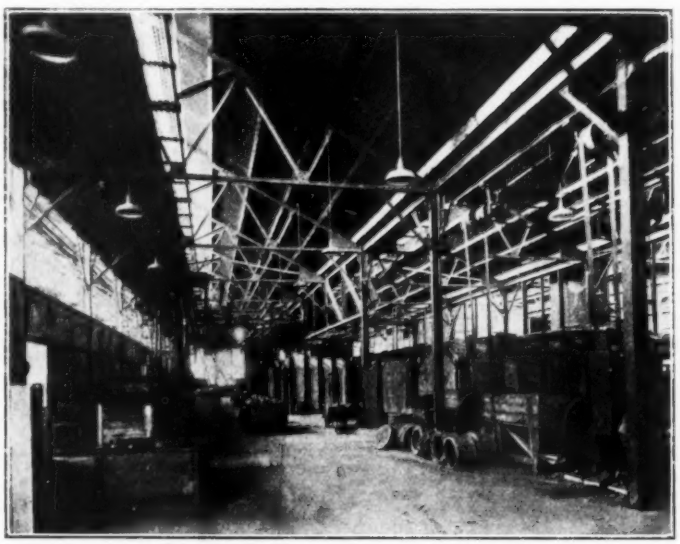


Fig. 4.—The Annealing Furnaces, Messrs. Crane-Bennett, Limited.

The Final Processes.

After unloading, the castings are tipped from the pots on to benches for sorting and inspection. They carry an excellent skin, so good that it appeals to one as sacrilege to remove it. However, industrial conditions make it desirable that the castings should be straightened, any flashes ground off and polished by re-barrelling. The castings are thus pressed between dies in upsetting machines, passed along to a battery of grinding machines and from there to the final tumbling barrels and so to the machine shops.

Radiator Foundry.

Metal for the radiator foundry is provided by a plant which is virtually the same as that already described for the malleable shop, except that the mixing ladle of the kettle-spout variety is tilted by a hand-wheel through gearing instead of by an operator sitting up a height. Moulding is effected by duplex machines, characterised by the use of a ramming plate, which, on lowering, sets into operation a special rammer. It is not proposed to detail the operation of these machines, as they are of a special-duty type and are not generally applicable to the foundry industry. The moulds are assembled and cast on circuits, made up of a series of interconnected moving tables. Every time a box is cast, an air cylinder moves the circuit forward. Although the plant had only been in operation a fortnight at the time of our visit, the synchronisation was excellent, in spite of the fact that the staff had been recruited from the labourers, who had previously been engaged in the erection of the buildings, which, by the way, are all constructed from entirely British materials.

Sand Preparation and Distribution.

At the discharge ends of the circuits the castings and sand are discharged on to a chain-grate conveyor, which carries the castings through to an adjoining shop, whilst allowing the sand to fall on to an apron conveyor which carries the sand to an elevator feeding a rotary sieve. So far the practice is virtually the same as for the malleable foundry, but here a change is made in the practice, as in the radiator foundry the system sand has to do the duty of facing sand also. Thus we find that at this point magnetic separators and Simpson mixers have been installed. Here the requisite quantities of new sand and coal dust are introduced, and then the sand is sent down the band conveyor, being damped *en route* by the manual control of a water spray. Then, at the far end, it is revivified and distributed to the hoppers over the machines, beneath which are gratings opening on to conveyors which return it to the mixing plant. The cores are brought to the moulders in wheeled wooden boxes, and then by monorail and not by conveyors, as is the practice in some automobile foundries. In both shops the hoppers are painted white, whilst all furnaces are coated with aluminium, which gives a clean and pleasing aspect to the shops.

Cleaning and Finishing.

The castings are taken from the conveyor and carefully packed in large-sized tumbling barrels, where they can move, but not fall on top of one another. From the barrels they are taken to an adjoining shop where each segment is subjected to a water-pressure test. From there they are fed into a special machine-tool for facing and threading. Next they are transferred to an assembling machine, where the segments are built up into units. After passing through a second water-pressure test, they pass through a special paint room, are dried and transferred to storage.

Power.

It will be noted that throughout the foundries much use is made of compressed air. This is supplied at the rate of 1,500 cub. ft. per min. by a Reavel compressor, driven by a 1,000 r.p.m., 290-h.p. motor. It is of the vertical 2-stage variety type. It is operated in connection with a synchronous power-factor-correcting device. The output can be supplemented by bringing into operation two quadruple single-stage rotary compressors. In the power station three boilers for the steam heating of the shops has been installed.

Other Departments.

Patterns are made in a shop furnished with all modern plant, such as lathes, planers, woodworking machines, sanders and the like. The laboratory, as it exists at present, is of a temporary character, and a new suite is at present being furnished, adjacent to the radiator foundry, which will carry all modern equipment. A technical control of the strictest possible character is exercised throughout the whole of the factory, and in this connection Mr. Shepherd's Paper, which has recently been published in these columns, should be referred to, as we have purposely omitted these important details.

Social Welfare.

The administration is doing everything possible to create material happiness amongst its employees. Primarily, it has a work's doctor for their benefit. Then it has inaugurated a life insurance of a specially-generous character. A large canteen is at present being built to replace the old one, and the practice of providing a first-class meal at a few pence per head will be continued. The men are provided with a fine sports ground, and the success of the works teams reflect the general interest taken.

The works generally is possibly one of the best of its sort in Great Britain. The firm carries out the erection of its own buildings, and, in addition, the installation of all machinery and equipment. The results reflect the careful study that has been given by the competent staff of engineers responsible. It will be difficult to imagine improvements in the methods they have adopted in synchronising mechanisation and man-power.

The future plans of the company are already taking shape, and further factories, which will cover approximately 2½ acres, can be expected within the near future.

During these times of trade depression, it is a relief to find a company like Messrs. Crane-Bennett, Limited, who are not lacking in optimism and who are not in doubt about the best methods to adopt to meet foreign competition.

Finally, we acknowledge, with sincere gratitude, the help and facilities afforded to us by Mr. E. E. Lister (general superintendent), Mr. J. S. Watson (business manager) and Mr. H. H. Shepherd (the company's metallurgist).

International Illumination Congress, 1931.—The arrangements for this Congress (which is to be held in Great Britain from September 1 to 19) are now well advanced Members will spend two and a-half days in London, where a wide range of visits of technical and general interest, and a noteworthy display of lighting have been arranged by the London Committee. The Congress will then proceed to Glasgow, Edinburgh, Sheffield and Birmingham; one day in each city is to be devoted to Papers, including some on lighting of mines, and discussions on illumination. Visits of varied interest have been organised, and members are invited to attend a reception by the civic authorities in each of these cities. The last week of the Congress will be at Cambridge, where the plenary sessions and technical meetings of the International Commission on Illumination will take place. The Congress is open to all interested in illumination, a registration fee of £2 being payable (ladies will be registered free); the fee includes a copy of the Proceedings of Congress.

International Foundry Exhibition and Congress.

MILAN, SEPTEMBER 12 to 27, 1931.

Foreword.

At the end of 1926, immediately after the Detroit Congress (U.S.A.), the International Committee of the Foundry Technical Associations was founded in Brussels. The Chairmen of this Committee were the following: P. Ropsy (Belgium) for 1927, Dr. S. G. Werner (Germany) for 1928, S. T. Johnston (United States) for 1929, C. Vanzetti (Italy) for 1930, and A. Damour (France) for 1931.

Among the principal aims of this Committee is that of regulating intercourse between the different technical associations, promoting the progress of the foundry industry and fixing the dates of the Congresses in the various countries in order to avoid chaos arising from clashing with other similar events. After the Foundry Congresses and Exhibitions of Paris in 1927, Barcelona in 1928, London in 1929, Liége in 1930, Italy has been chosen for the International Congress and Exhibition in 1931.

The next Congresses will be held in the following countries: France in 1932, Czecho-Slovakia in 1933, United States of America in 1934, and Germany in 1935.

The Exhibition.

The Exhibition will be held in the Machinery Hall of the Milan Sample Fair. It will remain open from September 12 to September 17. It has been divided into the following groups:—

Group I.—Raw Materials.

Class 1.—Ores, fuel, metals, alloys, flux, refractories.

Class 2.—Sands, corebinders, sea-coal, blacking, and other materials generally used in foundry practice.

Group II.—Castings.

Class 3.—Rough and finished castings.

Class 4.—Artistic and ornamental castings.

Class 5.—Machines in which the cast parts represent the principal element.

Group III.—Foundry Equipment.

Class 6.—Melting and heat treatment, apparatus and ovens: (*a*) by combustion; (*b*) by electricity.

Class 7.—Patterns, pattern plates, materials and equipment used in pattern shops.

Class 8.—Foundry tools.

Class 9.—Apparatus for sand-treating.

Class 10.—Moulding machines.

Class 11.—Casting machines.

Class 12.—Materials, tools, and machinery for shaking out, cleaning, chipping and repairing castings.

Class 13.—Hoisting and conveying apparatus and interdepartmental transportation.

Class 14.—Testing machinery, measuring apparatus, laboratory instruments and materials.

Class 15.—Lighting, heating and ventilation.

Group IV.

Class 16.—Technical and professional schools.

Class 17.—Technical literature.

Class 18.—Foundry organisation.

Group V.

Class 19.—Historical.

The Congress.

The Congress which will take place during the Exhibition will be the first International Foundry Congress ever held in Italy. It would be superfluous to insist on the importance of this event, which will lead to a friendly meeting of the best foundry technicians from all over the world, and all those who are interested in the technical and industrial problems.

The Italian members of the Congress, who have always received cordial receptions from their foreign hosts, will be able toreciprocate this year the courtesies which they have received, and to accompany the guests during a rapid excursion through the different regions of Italy, which offer not only a particular natural, artistic and historical interest, but where work in the factories is highly specialised, and where the results of the united and concordant efforts accomplished by New Italy are most evident. The most suitable season for this excusion has been chosen for the Congress, which, after travelling through the Peninsula from the Alps to the two seas, will be closed in Rome, "The Eternal City."

Congress Programme.

The programme is as follows:—

Milan, September 12.—Opening of the Congress and of the Exhibition.

Milan, September 13, 14, 15 and 16.—Continuation of the Congress, visits to foundries in

(*Concluded on page* 242.)

A Group of Founders photographed outside the Works of Messrs. Henry Ford & Son, Cork.

Gating Iron Castings.*

By E. M. Handley.

To the older foundrymen who have learned by experience how large a gate a casting will require in order that it may be run properly, a discussion of formulæ for gating may not always appeal. However, when one considers that it has taken them half a lifetime to acquire such experience, and when, even then, they are not too sure that their guess is correct, what can be expected from the young foundryman who is just beginning? No one knows how much it has cost to bring the old foundrymen up to their present knowledge of gating. Only the scrap heap can answer that question.

With the present knowledge of cupola practice and iron mixtures the metal problem is fairly well taken care of. The latest developments in sand testing have taken the guesswork out of the grading of sand to be used, as well as the permeability, strength and moisture required. With the iron and sand taken care of, and with a reasonably fair pattern and flask, the chance of the moulders making scrap is to-day considerably reduced.

Frequently, however, with iron of the right temperature and with sand just right and the pattern and flask satisfactory, we still find, in the cleaning room, castings which have been scrapped due to a misrun, a scab, a draw-down, or due to slag. While one may charge the scab or draw-down to the sand, more often it is the effect of pouring the mould too slowly or too hot that has caused the castings to be scrapped. Moreover, misruns and slag defects are always due to gating inefficiencies. These four defects are the cause of a great deal of the present scrap, and any method which will enable founders to improve their gating and pouring should be welcomed by all foundrymen.

Value of Gating to Jobbing Shop.

On production work this question of gating is not so serious. If the first few castings are scrapped before the proper size of gate is determined, these few castings will not be noticed on the scrap percentage of the job. However, in the jobbing shop where six castings are a large order, if the first few castings are scrapped due to misruns or slag, or some other gating trouble, the possibility of making a profit on the job is very small. When iron analysis first came into use the men in the foundry had to learn to use the data supplied by the chemist. When sand testing came into use, the foundry had to learn how to use sand-testing methods. Thus, the same process will have to be gone through in introducing any new development in our gating practice.

Calculating the area will not solve all gating problems. It will not tell a moulder where to place his gates, or whether the iron should be poured hot, medium or dull. These are things for the foundryman to decide, and as each shop has its own iron mixtures and grades of moulding and core sand, in like manner will foundrymen have to decide the proper factor to use when calculating the gates on their individual classes of work. When one sets up a sand-testing method in the foundry, this has a beneficial effect on the moulders. They watch the condition of their sand much more closely than when they were not checked, and they pride themselves on being able to tell whether or not their sand is right for casting purposes.

Stimulating Moulders' Interest.

If this method of calculating the size of a gate does no more good than to stimulate the discussion of the subject among foremen and moulders, it will still be worth while. Among the many things that are required in producing a sound casting, the mould should be poured in a fairly definite time. The pouring time, or the time required to pour the mould, will determine the progressive setting of the iron, as well as, to a large extent, the physical factors affecting the casting. A progressive setting of the molten iron from the far end of the gate is desirable, in order to decrease strains in the casting. Many castings are lost because the pouring time is not correct. Heavy sections, which are liable to shrink, often can be fed easily by filling the mould a little more slowly.

Two Gating Essentials.

The gating of castings is an art, an art founded on certain basic principles. Two things which must be known about any job before attempting to calculate the gate area are the metal thickness and the weight. Knowing these two factors, together with the factor used for each metal section, all that remains is to place them in the gating formula and calculate the gate area. There is no reason why this cannot be done in the pattern shop before the job is sent to the foundry, as this will relieve the foundry of a considerable part of the delay which many shops now experience. The author assumes no originality for these mathematical formulæ. The formulæ are taken just as presented to the industry by H. W. Dietert, and as applied to his own foundry conditions. They have proved to be very helpful, and it is hoped that, by passing them along, they may prove of some benefit to others as well.

Factors in Pouring Time.

As stated before, the pouring time, which is the time in seconds required to pour a casting, is of first importance. This depends on two factors, as follow: (1) The ferrostatic pressure (liquid pressure determined by the height of the sprue) at the choke, and (2) the area of the reduced section of the gate called the choke.

To calculate the area of the choke, two calculations are necessary. The area of gate required will depend upon the weight of the casting and the ferrostatic pressure, or effective sprue height, for castings of a classified metal line. The greater the ferrostatic pressure, the smaller will be the gate required. The ferrostatic pressure will diminish for moulds gated at the bottom of the mould, as the iron level rises in the mould. This also applies to moulds gated below the mould top. Under these conditions a varying iron head or sprue height will exist. This requires that we use the average or effective sprue height for calculating the area of the gate.

Calculating Effective Sprue Height.—The effective sprue height of a casting is obtained by means of the following formula:—

$$\text{Effective sprue height} = \frac{2H \times C - (Ca)^2}{2C}$$

where H = height of sprue above choke; C = height of casting, and Ca = height of casting above choke.

Calculating Area of Choke.—The result of the above formula gives us the ferrostatic pressure at the choke, and has been designated as E. S. H. (effective sprue height). Knowing the value of E. S. H. and the approximate weight of the casting under consideration, it is a simple matter to obtain the area of the choke for castings of a classified metal thickness.

Thus, if W represents the weight of the casting, the following formula is obtained:—

$$\text{Area of choke} = \frac{X \sqrt{W}}{\sqrt{E.S.H.}}$$

The value X in the above formula is dependent upon the metal thickness of the casting and upon any other condition which might be presented in the production of a sound casting. Consideration must be given, for instance, to heavy lugs or bosses in the casting which cannot be fed with risers, to corners which may show segregation or shrinkage if poured too rapidly, or to thin-section castings which cannot be poured with skim cores in the gate due to a lack of pressure sufficient to force the molten metal into the remote thin sections of the mould. Such castings must have gates with chokes calculated very carefully in order to prevent the entrance of slag particles into the mould and, at the same time, to run the casting without undue strain due to too great a head pressure.

Pouring Temperature.

Another factor of importance is the metal temperature at the mould. At all times the metal temperature must be considered when gating a mould to produce a sound casting. Unless care is taken to pour at the proper temperature, careful designing of the gate will not produce a sound casting when the casting contains heavy bosses that cannot be reached with a feeder. Pouring such moulds with extremely hot metal is the cause of heavy losses in both the foundry and machine shop. The old practice of melting metal as hot as possible, and cooling to the proper pouring temperature for the particular job in hand, still is good advice.

* Extracted from a Paper presented before the Wisconsin Gray Iron Foundry Group and the Chicago Foundrymen's Club, and printed in the Bulletin of the American Foundrymen's Association.

International Foundry Exhibition and Congress.

(*Concluded from page* 241.)

the city and surroundings, receptions, banquet. Excursion in the region of the Lombardy Lakes if the weather is good.

Turin, September 17, 18 and 19.—Trip to Aosta; visit to the steelworks and mines of Cogne; visit to the Olivetti foundries at Ivrea and visit to the Fiat works and others. Receptions.

Genoa, September 20 and 21.—Visit to the Harbour, the Ansaldo works, the Fonderia Tubi di Cogoleto of the Ilva and others. Receptions.

Rome, September 22 to 27.—September 22, sight-seeing. September 23 and 24, Terni, visit to the works of the Società Terni. Reception and excursion to Umbria (Assisi, Perugia). September 25 and 26, sight-seeing in Rome, closing meeting in the Capitol, reception by the General Fascist Confederation of Italian Industry, etc.

When the Congress is closed, members may leave Rome to visit other Italian cities which are the most renowned for their artistic riches and natural beauty, and go as far as Sicily *via* Naples, or *via* Florence and Bologna to Venice, Trieste and the Alps.

His Excellency the Minister of Communications, Count Costanzo Ciano di Cortellazzo, under whose high patronage the Congress will be held, has kindly given instructions that members may avail themselves of reductions amounting to 50 per cent. on the State railways, and other travelling facilities which will be announced later, and since a tourist agency, to which the organisation of the movements of the Congress from Milan to Rome has been entrusted, will also have charge of the travelling, when the Congress shall have been closed, members may be sure of being able to admire the various cities in the best possible conditions, and especially because, in each stopping place, committees for this purpose will prepare receptions for the guests, and parties of ladies will receive the wives of the members and organise special excursions and visits for them.

Those interested in this important event can receive all the supplementary information without any engagement on their part by writing to All' on Comitato per l' esposizone e il Congresso Internationali di Fonderia, Via Verdi No. 11, Milano, Italy.

The Distribution of Power.

By "Kilowatt."

While the general principles controlling the distribution of power, with the switchgear involved, have formed the subject of many excellent technical Papers and publications, the following notes have been compiled as being applicable to foundries in particular. In large foundries consideration should be given to the expenditure of extra capital on duplication of feeders with switchgear to ensure regular running. The question may be a matter for compromise, but generally it may be justified. The additional cost involved is small in relation to the total cost of the works, and duplication facilitates the periodic inspection and testing of switchgear, which is essential.

Measuring the power taken by different departments of a foundry, the extent to which this is required, and how it is attained, will also affect the lay-out of feeders and distributors, a number of radial feeders often being necessary where otherwise a less expensive ring main would be suitable.

For switchgear controlling the primary 3,000-volt feeders, transformers and large motors, many types are available, with special claims made for each, but for the duty in view (where the chief considerations are moderate rupturing and current-carrying capacity, maintenance, flexibility, standardisation, metering and price), the commercially-designated "truck cubicle" gear will probably be found most suitable. Ironclad compound-filled gear has now been developed for industrial use, and sometimes finds a duty in the main sub-stations in large foundries.

For switching secondary or 500-volt circuits, ironclad oil-immersed draw-out unit gear may be used, and in selecting any given type the points referred to under the 3,000-volt switchgear also require consideration, although, perhaps, not to the same degree.

In regard to the question of rupturing capacity already mentioned, failure of switchgear from this cause, in addition to being a source of danger to human life, invariably results in cessation of supply and manufacture, which may be prolonged. That it has to be considered in relation to the 3,000-volt switchgear and circuits is fairly well recognised, but it is seldom appreciated to what extent it should be considered on the 500-volt circuits, where comparatively large powers have to be dealt with in a limited area (as often occurs in a foundry). The non-observance of this has, in some instances, meant damage to gear and loss of output owing to the failure of starters on small motors.

With ironclad switch and control gear, to ensure everything being sound mechanically and safe electrically, a totally metal-clad installation may be obtained by the use of paper-armoured cables on high-tension and low-tension feeders and distributors, and paper- or rubber-armoured cables or rubber cables in conduit between motors and starters. The efficient through bonding of all such cables and their connection to selected earth-plates on the system automatically earths all gears and motors, and also the installation as a whole.

What may be considered an integral part of the distribution system are the step-down transformers. These will be 3-phase units, varying in size from 1,000 k.v.a. to 100 k.v.a., and built to comply with the British Standard Specification. Standardisation of the size of transformers should be aimed at, and this, in large foundries, is facilitated by the advisability of sectionalising the units. The load the transformers have to deal with is chiefly a balanced motor load, and although star-star windings can be used, delta-star windings are suitable for dealing with some unbalanced load are preferable.

The lighting transformers will be of the same design and type as the power transformers, and when 110-volt, 3-wire distribution is employed will be of about 10-k.v.a. capacity, two or more being connected in parallel as the load demands.

Three Essential Features.

When considering the type of motor and control gear to be installed the three principal features to be kept in view are reliability, efficiency and initial cost, afterwards providing for such special conditions as overloads for prolonged periods, heavy starting conditions, operation in damp atmospheres, control by unskilled works labour and small opportunities for maintenance owing to long running hours.

The motors may be subdivided into two classes: the main units varying in power from 500 h.p. to 100 h.p., and the auxiliaries from 75 h.p. to 1 h.p. or less.

For both classes continuous rating is usually required, whilst for normal conditions full-load starting torque is generally adequate. Twice full-load starting torque is sometimes required for abnormal conditions, and since this can be obtained from an asynchronous-induction motor, it should be provided for on both the motor and control gear, except on large drives, where 1½ times full-load starting torque will meet every requirement, and catering for twice full-load torque increases the cost of both motor and control gear, especially the latter, beyond an economical figure.

Large motors driving compressors, presses, etc., should be high-tension machines of the slip-ring or the synchronous type. For starting or controlling these units separate stator switches, with hand-operated liquid rotor starters, are suitable. The remarks made earlier when dealing with 3,000-volt switchgear also generally apply to the stator switches. Liquid rotor starters of good design are advocated, since they are simple in operation, low in first cost and maintenance, permit of gradual acceleration, and appreciable intermittent speed control is obtained for repairing, inspecting, cleaning out, etc. This speed control calls for a higher rating than the normal starting duty required, but specifying two consecutive starts every four hours, against twice full-load torque with a starting period of one minute, will be found to meet all contingencies.

For almost all auxiliary drives a final low speed is called for, which was formerly dealt with by group drives with medium-speed motors; the necessary speed reduction is obtained through belts or rope drives on to countershafts, with a final gear reduction on the driven unit. Owing to the adverse conditions prevailing for belts and ropes, resulting in high-maintenance and renewal costs, preference was later given to individual drives with low-speed motors and intermediate spur or worm gears. To-day, with improved high-speed gears, the tendency is to adopt individual drives with high-speed motors and large ratio double- or single-reduction machine-cut spur or worm gears, the gears being either separate units direct coupled to the motors or built into the motors to form one unit. High-speed motors and gears for the powers in question may entail slightly higher first cost, but higher efficiency, lower maintenance, improved electrical performance and reduced housing space required may make them the more economical proposition.

High-Efficiency Drives.

The higher efficiency and power factor and more robust construction of the squirrel-cage motor makes its adoption desirable for these smaller motors wherever possible. Although special care is required in its application, the squirrel-cage motor would be considerably more used, even on drives requiring heavy starting torques, if the characteristics of the standard and high-torque types were better understood. The combination of the centrifugal-clutch pulley or coupling with the standard squirrel-cage motor appears to be an attractive proposition, but its adoption requires caution.

The high-torque machine, with the correct method of starting, has proved an unqualified success up to 30 h.p., even on heavy-starting duties.

Above 30 h.p. the wound rotor (slip-ring) machine should be installed except for light-starting duties on account of the excessive starting currents to be dealt with when using the squirrel-cage machine, and the expense and difficulty of obtaining suitable standard control gear.

Starters for auxiliary motors should be of the standard ironclad, oil-immersed, industrial type. For overload protection, standard overload trips, with or without inverse time lags, are usually fitted, but, since motors driving auxiliary machinery are sometimes submitted for long periods to dangerous overloads, against which this type of trip affords no adequate protection, thermal relays are strongly advocated for this duty.

For slip-ring motors, separate stator switches and rotor starters should be used, the latter being oil immersed and heavily rated. It will generally be found suitable to have both switch and starter built as one unit, suitable for floor mounting.

Reference to the gearings for motors is not out of place in view of the claims now made for ball and roller bearings for all sizes and types of machines. Whilst they are strongly advocated for end-shield motors up to 100 h.p., the difficulty of replacing and repairing this class of bearing on large motors must not be ignored. Also, where motors are direct-coupled, the difficulty of replacement occasioned by the half-coupling is substantial. The only commercial advantage that can generally be claimed for a large ball or roller bearing over a well-designed sleeve bearing is a possible saving in lubrication, which in practice is often found to be more than counterbalanced by other maintenance costs.

Special Applications.

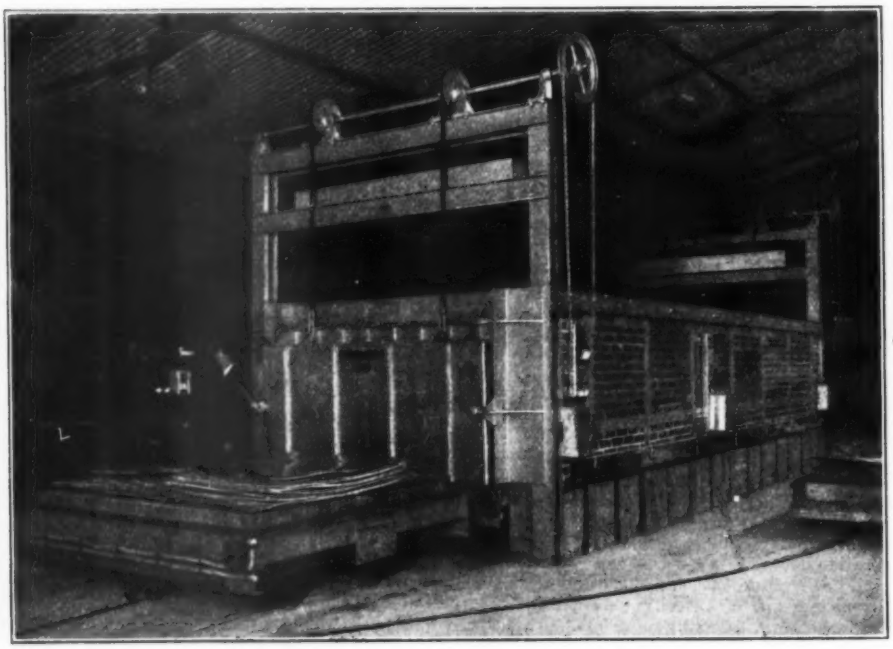
Having dealt with electrical power as generally affecting the foundry, such a subject would not be complete without some reference to some of the special applications. The equipments for cranes does not call for comment where a direct-current supply is available. On an alternating-current system, however, advantages are sometimes claimed to-day for high-torque squirrel-cage motors over slip-ring machines, but under working conditions the latter have proved the better commercial proposition.

Each variable-speed drive will call for special investigation on an a.c. system, but the following generally applies for foundry plant. Where the power is not above 100 h.p., and a constant torque at any given speed, combined with a large range of speed variation, is not required, the less costly and simpler slip-ring motor, with rotor resistance, will be satisfactory at some loss in efficiency. The same may be said in cases of intermittent duty, but for any power where continuous operation over any speed range and constant torque at any speed is required, the commutator, motor built, has been found efficient and satisfactory, in spite of the appreciably higher first cost. Conversion to d.c. and using d.c. motors may be justified where small powers are involved.

Tight Belts Cost Money.—Many motor bearings are burned out by reason of too tight a belt. It is often difficult to know just what belt tension will stand. The only sure procedure is to watch it carefully for a little while after each take-up. This responsibility should not, however, be left to a machine operator unacquainted with motor operation.

Electric Annealing of Aluminium.

There has been considerable growth in the industrial uses of aluminium during recent years, and very marked progress has been made by the producers of the metal and its alloys to ensure a very high-grade product of known physical characteristics. One of the largest and most important works in this country devoted to this purpose is that of the Aluminium Corporation, Limited, which is situated at Dolgarrog, Carnarvonshire. In addition to the extensive plant required for the production of aluminium in ingot and bar form, there is an extensive and most modernly-equipped rolling mill for the manufacture of every kind of sheet product. The Aluminium Corporation is thus enabled to supply its product to each industry in the form most suitable for the particular purpose to which it is to be applied. To enable this to be done the Dolgarrog Works have been maintained at the highest standard of efficiency by the installation of the most modern equipment in every department. In order to facilitate the very precise annealing of aluminium sheets on a large scale, the G.E.C. has recently installed a large single-track multi-car type electric annealing furnace, which has an effective hearth area 24 ft. long by 7 ft. 5 in. wide. This furnace has an electric loading of 150 kw., the heating elements being arranged to ensure phasal balance on a 440-volt, 3-phase, 50-cycle supply.



Large G.E.C. Resistance Furnace for Annealing.

The correct disposition of heating elements in a furnace of this size is of primary importance. Composed of high-grade nickel-chromium alloy, the elements are placed on the side walls and in each section of the car hearth, and also suspended from the roof. Those in the car hearth each constitute a self-contained and independent unit or circuit, and an interesting feature of design is the substitution of running contacts for the trailing cables more usually employed. This eliminates the danger and inconvenience which is invariably associated with trailing cables in such circumstances. The running contacts are situated below the cars, and are therefore virtually outside the furnace proper and not subjected to the heat of the furnace. The roof elements are suspended by the patented method of the General Electric Company, which ensures long life by relieving them of all strain and stress due to expansion and contraction. The furnace is controlled automatically by gear supplied by the Cambridge Instrument Company, Limited, and works in conjunction with G.E.C. Witton contactors. Fitted with this automatic-control gear the furnace is operated at a temperature within 5 deg. of any setting of the instrument. An electrically-driven time switch is capable of bringing the furnace to temperature in time for work to commence on Monday morning, the furnace being closed down for the week-end.

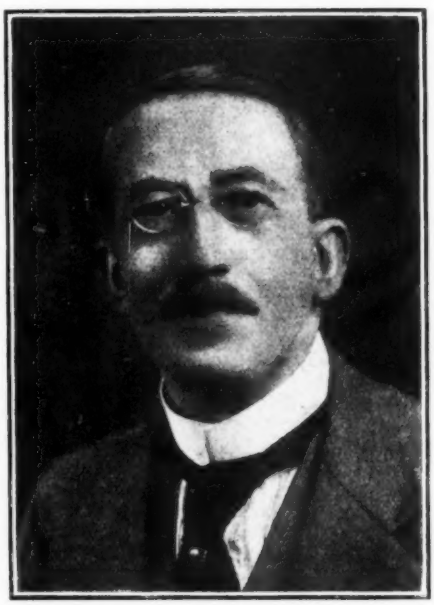
The doors at each end of the furnace are of the suspended counterweighted type, well insulated and sand-sealed, both at the top and bottom. Special switches are provided which automatically switch off the current from the car hearth when the doors are raised and similarly switch on when they are closed.

The equipment comprises six cars or trolleys, on which the aluminium sheets are piled. There are four cars in the furnace at one time, and the two others are provided to facilitate cooling, loading and unloading. These cars are effectively sand-sealed along both sides and at the furnace ends, and there is also an adequate seal between the ends of the adjoining cars. As each car is unloaded it is returned to the charging end along a rail track running parallel with the furnace. It is of interest to note that this new Magnet furnace occupies the site of an older type of electric furnace which it has superseded, and is turning out a product of exceptional regularity and quality.

Mr. Wesley Lambert, C.B.E.

Mr. Wesley Lambert, C.B.E., Past-President of the Institute of British Foundrymen and member of Council of the Institute of Metals, is relinquishing his position as manager of the metallurgical department of Messrs. J. Stone & Company, Limited, the well-known non-ferrous founders of Deptford and Charlton, after nearly 20 years' service with that firm.

Mr. Lambert formerly served under the War Office as chief metallurgist of the Royal Gun Factories at Woolwich, where he had the reputation of being one of the foremost steel metallurgists in the country. In 1912, upon the recommendation of the Admiralty, he was notified by the Lords Commissioners of His Majesty's Civil Service that he had been selected to take charge of the laboratories of the Department of the Inspector of Steel at Sheffield, but being approached at this time by Sir Frederick Preston, the chairman of Messrs. J. Stone & Company, he resigned his new appointment under the Admiralty to take service with the commercial firm, with whom he has been so long associated. The establishment of the present chemical and mechanical laboratory of Messrs Stone & Company was one of his first efforts, and it is not too much to claim that his association with the staff of that firm has done much to enhance its reputation.



Mr. Wesley Lambert, C.B.E.

Few technical metallurgists in Great Britain can possibly have had the opportunities to garner such a wealth of experience as has fallen to the lot of Mr. Lambert—experience gained not only in this country, but by visits paid to many countries abroad. Few metallurgical operations connected with either the ferrous or non-ferrous industries are hidden mysteries to Mr. Lambert. This wide experience, coupled with a retentive memory, is reflected in the numerous technical Papers given before various societies throughout the country, and the authoritative contributions which he has made whenever called upon to take part in the discussion of Papers presented by other authors. It is within our knowledge that very few technical committees relating to either ferrous or non-ferrous technology are constituted without Mr. Lambert's name being proposed in one or other capacity as a member of such bodies. No name is more prominent in the foundry industry to-day.

Mr. Wesley Lambert is not entirely severing

(*Concluded from next column.*)

his connection with Messrs. J. Stone & Company, it being understood—subject to correction—that he is under "agreement and retainer" to act in an advisory capacity to his old firm should the benefit of his services be requested. It is not Mr. Lambert's intention to seek further regular employment, but to those to whom he is known it is inconceivable that such an active and enthusiastic gentleman, with his wealth of knowledge and experience, will be permitted to enjoy more than a brief rest before one hears of his joining the ranks of the consulting specialist or of his becoming associated as technical director on the board of one or more of the prominent metallurgical works in Great Britain.

We offer to Mr. Lambert our very best wishes for his future health, wealth and happiness.

(*Concluded in previous column.*)

The Reactions in the Shaft of the Cold-Blast Furnace.

By Colin D. Abell.

Physical Condition of the Materials (two phases only, solid and gaseous).—Average temperature range, 250-1,000 deg. C.; stockline diameter, 12 ft. 6 in.; depth of the stockline, 10 ft.; diameters of the shaft, (1) 12 ft. 6 in. and (2) 15 ft.; and depth of the shaft, 37 ft.

In the first stages, the preliminary changes are the drying of the ore and fuel, in which all the free moisture and nearly all the combined water is driven off. Probably as the temperature rises and the burden gradually works down some dissociation of steam takes place by reason of the oxides of iron present:—

$$2FeO + H_2O \longrightarrow Fe_2O_3 + H_2 \qquad (I)$$

especially if a proportion of calcined stone has been charged, which may contain some ferrous oxide.

As the temperature gradually approaches 500 deg. C., the tendency at the lower regions is for the reduction of the oxides of manganese and iron to take place. The oxides of iron are reduced first of all.

$$FeO.Fe_2O_3 \longrightarrow 3FeO + O$$
$$Fe_2O_3 \longrightarrow 2FeO + O$$
$$FeO \longrightarrow Fe + O$$

The oxides promote the formation of carbon dioxide and carbon by the catalytic dissociation of the carbon monoxide; the carbon being in a very fine state of division reduces directly the ferrous oxide present giving carbon monoxide. The ease with which the iron oxides are reduced may be easily seen on a small scale by the formation of a metallic powder from a calcined stone by means of coal-gas. The reduction of the iron oxides is practically complete at 500 deg. C., and between 600 and 900 deg. C. the oxides of manganese are reduced in intimate association with the reduced iron-residue (or iron-sponge).

After which the iron-sponge is carried down until the temperature reaches 1,000 to 1,100 deg. C., at which stage the phosphorus is reduced from the phosphates present in the charges. At this temperature also the reduction of a large proportion of the silica is completed. Usually the amount of silicon obtained in the iron-residue is greatly in excess of that finally found in the pig-iron as cast, the difference being *oxidised* in the hearth.

The zones of the lower shaft and the upper-bosh overlap to a certain extent, and hence the zone or region of the reduction of the silica to silicon, and the reduction of the phosphates to phosphorus or to phosphides is also included in the reactions of the upper-bosh.

It is apparent from the fact that the dissociation of the carbon monoxide is only considerable at temperatures below 500 deg. C., that a low top-temperature is desirable in order to get the advantage of this reaction. The low temperature of the top-gases, obtained by heating the blast, enables the separation of large quantities of carbon, and herein lies a hitherto unrecognised essentially favourable effect of the hot-blast process.

The carbon formed by this dissociation causes at lower zones the processes of reduction as follow:—

$$FeO + C \longrightarrow Fe + CO$$
$$FeO + CO \longrightarrow Fe + CO_2$$

$$SiO_2 + 2CO \longrightarrow Si + 2CO_2$$
$$SiO_2 + 2C \longrightarrow Si + 2CO$$

$$P_2O_5 + 5CO \longrightarrow 2P + 5CO_2$$
$$P_2O_5 + 5C \longrightarrow 2P + 5CO$$

The dissociation of the limestone in regions where the temperature reaches 1,000 to 1,200 deg. C. determines the final equilibrium of the reaction, giving the dissociation of the carbon monoxide in the upper zones of the shaft; owing primarily to the nature of the equilibrium constant of the reaction, viz.:—

$$K_{CO} = \frac{(C) \cdot (CO_2)}{(2CO)} \qquad (2)$$

from which it is seen that if from any causes the concentration of the carbon dioxide increases, then a corresponding amount of carbon which has been deposited must be reconverted into carbon monoxide and the temperature of the zone rises, thus producing a greater consumption of carbon in that region and a corresponding loss of carbon as gas (carbon monoxide). This produces further complications at lower levels in the shaft, since there will be a relative deficiency of carbon to perform the direct reduction of the remaining oxides of iron, manganese, silicon and phosphorus; reducing by this means the available carbon which can be burnt in the hearth and bosh to give useful heat. The sum total of this so-called "solution-loss" of carbon as carbon monoxide is a high top-temperature, high zone-temperatures and a generally irregularly working furnace.

Metallurgical Refractories.*

HIGH-ALUMINA FIREBRICKS.

The alumina content of ordinary straight firebricks generally lies between 18 and 38 per cent. Within these limits of composition it is possible to obtain a wide range of physical properties. With, however, the increasingly-severe conditions imposed on metallurgical furnaces and other high-temperature plants the adoption of higher-quality refractories has become imperative, and now the mass production of firebricks with alumina contents of 40 per cent. and over has become, not a luxury, but a necessity.

The advent of firebricks, and other special materials rich in alumina, can be likened, in their own particular field, to the advent of alloy steels in engineering. The evolution is not just wholly the replacement of the old materials by the new. It is more a case of the use of high-alumina material in processes where straight firebricks cannot be employed economically, if at all, owing to the severe working conditions. Many difficulties have had to be overcome before even a modest production of high-alumina bricks was a commercial proposition. Aluminous clays, generally, are exceptionally difficult to manufacture, for, on heating, such clays contract excessively, and they require to be burned very completely and thoroughly.

It is of more than passing interest to examine the main features of high-alumina firebricks. To do so clearly it is perhaps well to state the most important characteristics of a refractory. These are its resistance:—(*a*) To temperature; (*b*) to solution and disintegration by fluxes and dust-laden gases; (*c*) to rapid temperature changes.

A firebrick consists essentially of numerous crystals of mullite [$3\ Al_2O_3.2\ SiO_2$] and silica cemented together by a siliceous glass. From a consideration of the phase equilibrium diagram† of silica and alumina it is seen that the more mullite crystals there are present, the less liquid is there formed when high temperatures are reached. And since the mullite content of a brick is proportional to the alumina content, it follows that the refractoriness increases with increasing alumina. Likewise the resistance to deformation, when under compression or tension, increases with alumina content. This statement is only valid, however, if the bricks have been properly fired. For high resistance to temperature, including resistance to imposed stresses, the conclusion is that it is desirable to have a high alumina, and thus a high mullite, content in a firebrick.

Action of Fluxes on a Refractory.

The second point to consider is the resistance of a refractory to solution and break-up by energetic fluxes. The majority of fluxes are basic in nature. Slags, for example, are generally high in metallic oxides. They are, therefore, very fluid and chemically very active, and it is common knowledge that silica at high temperatures is rapidly used up in an attempt to form stable silicates. Mullite, on the other hand, is relatively inert towards bases, and shows good resistance to active basic fluxes. For maximum resistance to corrosion by slags rich in metallic oxides it is best, therefore, to have bricks high in mullite. The less free silica in a brick, the less liable it will be to attack by bases.

These remarks on resistance to temperature and corrosion not only hold for refractories with alumina content up to 72.8 per cent., but when the alumina exceeds this amount the silica phase disappears and the material is composed of corundum and mullite, and here, again, there is enhanced resistance to both temperature and corrosion, with increase in the number of corundum crystals.

The third point under consideration—and it is often of considerable importance—is the resistance of a brick to rapid changes in temperature. It can be shown that the resistance of a brick to spalling depends largely on its tensile strength, coefficient of expansion, and elasticity. Up to 800 deg. C. the expansion which takes place in a normal firebrick approaches 90 per cent. of the total expansion up to 1,300 deg. C. Moreover, under 800 deg. C. a brick has greater rigidity and less elasticity than at higher temperatures, so that true thermal spalling sensitivity is tied down to the temperature range up to 800 deg. C. Spalling tendency is greatly increased by the presence of free silica, for it usually exists as cristobalite, which has a reversible expansion of considerable magnitude at 220 deg. C. Once again the advantage of keeping the free silica low and having a high-alumina brick is demonstrated. It should be noted, however, that refractories with alumina content of 60 per cent. and upwards tend to become more liable to spalling, since the expansion coefficient increases with alumina content.

Cost of Production.

The cost of production of refractories rapidly increases with rise in alumina, and only for extreme cases is it economical to employ materials with high alumina derived from diaspore, bauxite, cyanite or corundum. For clays with alumina approaching 45 per cent. there is a big field of usefulness. Properly made, bricks from such clays show high resistance to temperature, as well as to corrosion and to spalling.

The position of high-alumina refractories can best be realised by stating some of the major applications. These are: (*a*) Boiler linings, (*b*) slag lines in metal furnaces, (*c*) lime-kiln linings, (*d*) cement-kiln linings, (*e*) structural components demanding high strength, (*f*) positions exposed to severe punishment by iron oxide or alkalies.

High-alumina bricks are more used in non-ferrous than in iron and steel furnaces, but there is little doubt that in ferrous metallurgy they will eventually be widely used in positions where high resistance to temperature and corrosion is required.

* Extract of an article by Mr. J. F. Hyslop in the Royal Technical College Metallurgical Club Journal (Glasgow).

† W. L. Bowen and J. W. Greig. Jour. Amer. Cer. Soc. 1924, vol. 7, No. 4, p. 231.

Mr. J. W. Allbrighton, who was for 37 years on the staff and latterly a director of Messrs. Dewhurst's Engineering Company, Limited, of Sheffield, has commenced business on his own account under the style of Lancanite Rubber Products, with offices at 15, Westfield Terrace, Sheffield. Mr. Allbrighton has also been appointed representative of Messrs. George Brown & Bros., Limited, builders of blast-furnace and steelworks plant, of Stockton-on-Tees.

Some Notes on Enamelling Castings.*

By A. M. Cleverley, B.Sc.

It would cover much too wide a field to deal with the whole subject of enamelling, but in view of the great changes taking place in the finishes required for cookers, ranges, interiors and the like, it might be as well to view the subject from the moulder's point of view.

As to the type of iron required, there is no need to dogmatise on the subject, for having enamelled castings from many foundries in various parts of England and Scotland, the author has not had any trouble which could be ascribed to the type of metal used. In all probability, however, the general type of iron was essentially the same; one reads of moulds having to be cast hot, but this really helps to fulfil one of the conditions to be discussed—that is, the question of sound castings.

In connection with the dry process of enamelling—especially for castings like baths—alteration in the composition, with consequent alteration in the coefficient of expansion, does require consideration, and at times grave trouble is experienced here. One of the main points essential to success, especially in wet-process enamelling, is that the castings shall be sound. There should be no run blackening, scabs, and the like. The castings need not have a smooth surface, for the sand-blast will roughen any smooth surface, so that it is useless expending labour on doing something which will be obliterated, and which serves no useful purpose.

Where conditions permit, the castings should be sent to the enameller as soon as possible after being made, for although castings may be in a relatively dry place, they are absorbing moisture all the time, and, especially in porous spots, may give rise to trouble. With regard to dressing, all gates should be neatly removed; many jobs are spoiled through neglect of this point. Another point is that no faking of castings should be permitted; this has ruined many an otherwise perfect job. Even though the casting may pass the stocktaker, the moulder should still be held responsible for any faked work. Patent cements and patches of lead will all be blown out during the process of sand-blasting. Unfortunately, however, at times even such work may pass through various hands in the enamelling shop before it is observed, and much work may have been put on it by then.

Design of Castings.

Sharp edges should be avoided, for the enamel will run away from these during firing, leaving unsightly black lines, especially if the enamel is of a light shade. A slight chamfer-off on the working patterns will be well repaid. Wherever possible the section of the castings should be uniform, for two reasons: (1) Porous metal is formed at the heavy portions, giving at times almost unsurmountable trouble during enamelling, and (2) there is a great tendency for the enamel not to fuse correctly over the heavy bits, causing pinholes. With a casting having thick and thin sections, the enameller may fire up the thin sections (leaving the thick sections unfired) or fire up the thick sections (overfiring the thin sections); or, more probably, after much tribulation, will find that he has to treat the castings in question separately, withdrawing them when the thin sections are nearly fired, letting them cool, and then putting them back to fire up the thick parts (just as the cooling strains in a complicated casting are sometimes evened up).

Allowances should also be made for the growth of the castings. During the heating-up and cooling-down of the castings, whilst passing through the various stages of the enamelling process, growth does take place, and this is sometimes not allowed for. Cases have come to light where an article is in two pieces, which previously aligned up well, but after enamelling one piece had actually grown more than the other. Also, during the fitting, allowance should be made for the thickness of enamel which will be applied to the casting.

Treatment after Enamelling.

It must be understood that, as a result of the wet-process enamelling, much more can be done to the finished article than previously was the case. Thus, as at times happens, castings are enamelled which should have had a number of holes drilled in them. However, these can be drilled with perfect safety without any splintering. This could not have been done without splintering the enamel in the case of an article which had been dusted. The reason, of course, is that in the wet-process method of enamelling, the coating of enamel is so thin and actually grips the casting so well (probably due to the cutting action of the sand-blast on the surface of the casting), whereas the grip of a dusted job is not so good. The coat of enamel is also much thicker, with consequently greater strains on cooling.

Fitting of Enamelled Castings.

Enamelled sheet-iron parts are more fragile than the castings, because, after all, enamel is only a glass, and the treatment sometimes accorded an enamelled sheet would assuredly not be given to a pane of glass, thus if the sheet-iron casings do not screw up well to the castings (due possibly to the movement of the nuts in the mould during casting) they should not be screwed up and forced home. A gentle rime with a rat-tailed file will remedy matters; moreover, the castings should not be screwed up tightly, for if there is a strain, then the jolting during transit will accentuate it, and another "damaged in transit" article will be added to the long list which is adding to the cost of production.

Warping of Castings.

Whilst there is much less warping of castings during enamelling by wet-process methods than with the dusting process, due to the lower temperature of the muffle, there are at times warpings due entirely to the fault of the casting, or rather to the fault of the design. If a casting has a twist or bend on it, this bend or twist will often enough be made worse during enamelling. Annealing seems to release that strain, and it is practically impossible to remedy it. It would be, if it were possible to give each piece individual attention, as is done in the dry process, but the wet process is essentially a mass-production job. The articles should be such that if laid flat on the supports in the muffle they will come through quite flat.

A man will put 20 tons of castings through the annealing and colouring processes in five night-shifts, so that production would be seriously reduced if he had to dally over putting weights over a warped casting. As a matter of fact, castings do come from the sand-blast warped at times, but these castings straighten out on being fired (these strains are different from those due to casting strains).

Reverting to the process itself, apart from the lessening of warping, a great virtue of the wet-process method is that enamel need only be applied to the surfaces required to be covered. In the case of dusting a casting, this is hardly possible unless great care is taken, but where the enamel is sprayed on it can be removed and cleaned off where it is not required before being fired.

* A Paper read before the Falkirk Section of the Scottish Branch of the Institute of British Foundrymen.

Moler Products, Limited, 49, Moorgate, London, E.C.2, have recently received contracts for a total of 70,000 "Fosalsil" heat-insulating slabs for generating stations in the Midlands and for export. Contracts for a total of 220,000 "Fosalsil" heat-insulating bricks and 30 tons of "Fosalsil" pipe-covering composition were also received from one of the largest gas companies in the south of England and for export.

Publications Received.

A General Guide to the Vereinigte Stahlwerke (United Steelworks) A.-G. Düsseldorf.—This 68-page booklet is designed to show the relative importance of the combine, its constitution and production. The first phase can be brought out by pointing out that the firm makes 50 per cent. of the German pig-iron production or 15 per cent. less than Great Britain. In steel, Great Britain produces 38 per cent. more than the Vereinigte Stahlwerke.

The constitution is made up of the Rhein-Elbe Union, the Thyssen Group, the Phœnix and the Rheinische Stahlwerke, and controls 112 collieries, 26 coke-oven installations, 56 blast furnaces, 33 Bessemer converters, 111 open-hearth furnaces, 6 electric furnaces and 250 rolling mills, the metallugrical activities being carried out in about 40 separate establishments. Naturally, such information can be strikingly presented, but not so the productions, and resort has been made to an excellent series of photographs, numbering about eighty, which range from aerial views of the various works down to illustrations of such smaller products as forged steel balls.

Index to the Proceedings of the Institution of Mechanical Engineers, 1911 to 1920. Published by the Institution, Storey's Gate, St. James's Park, London, S.W.1.

This index is remarkable, so far as founders are concerned, in that for the decade under review there is no reference to cast iron. This is a curious coincidence, as in its early days and recently the Institute evinced a serious interest in the work of the foundry. There were two Papers during the period of outstanding interest to our readers, one by Sir Robert Hadfield on "The Metallurgy of Iron and Steel," and the other by Dr. W. Rosenhain on "Steel."

Merry & Cuninghame, Limited.

Mr. James A. Gordon has been appointed liquidator in the winding up, under supervision of the Court, of Messrs. Merry & Cuninghame, Limited, colliery owners and ironmasters, Glasgow. The winding-up petition was presented by the Clydesdale Bank, the principal creditor, whose claim amounted to £80,000, exclusive of interest. It was stated that the company was incorporated in 1891, with a capital of £250,000. In 1915, £200,000 mortgage debentures were created, of which £20,500 had been redeemed, and in 1926, £100,000 second mortgage debentures. No dividend had been declared on the ordinary shares since 1920, and none on the preference since 1924. The balance sheet for 1929 disclosed a debit balance of £245,271, and in the following year £183,380 of further loss was incurred. No debenture interest had been paid since May, 1928.

Mr. Justice Maugham, in the Chancery Division recently, appointed Mr. Robert Brown, of Coventry, receiver and manager of the company's English assets, which, it was stated, included a colliery in Warwickshire.

Catalogue Received.

Machinery.—The March issue of the catalogue of Messrs. T. W. Ward, Limited, Albion Works, Sheffield, contains some 490 pages, and illustrates, prices and describes an immense quantity of reconditioned second-hand material for industry in general, including a certain amount of foundry plant.

Cracks in Belts.—Continued use of a leather belt soaked in mineral oil will develop cracks from fibre abrasion inside. The natural animal oil in high-grade leather protects these fibres against sawing one on the other. Harsh mineral oil removes this film of natural animal lubricant, and allows the fibres to contact and develop abrasion.

Foundry Selling Practice.

By Eric N. Simons.

(*Continued from page* 205.)

No. 2. ADVERTISEMENTS.

The writing of advertisements is probably the most difficult of all the various types of commercial writing. For that reason it is probably the most carelessly attempted and the subject of the greatest number of fallacies. It is quite a common error to suppose that "anyone can write advertisements." Actually, an advertisement is a special piece of writing for a special purpose—the selling of commodities or services. To write successful advertisements is sometimes a natural gift, but more often the result of specialised study and practice, together with long experience of selling.

Advertisements cost money. They are probably among the costliest of all commodities purchased by a business. Yet one frequently sees their writing entrusted to anyone about the place who has the time to spare, or the managing director himself may write them in his odd moments. It is as if one were to entrust the use of X-ray apparatus to a crossing-sweeper or a master builder.

Principles of Successful Advertisement Writing.

Successful advertisement writing depends on understanding and grasp of four main principles:—(1) That the aim of an advertisement is to show in a full and satisfactory manner exactly how the manufacturer's goods are better than and different from those of any other; (2) that advertisements increase in strength and success in proportion as they convey facts rather than opinions or theories; (3) that advertisements of what the manufacturer thinks about himself and his goods carry no weight with the customer; and (4) that successful advertising is always based on a careful study of the market for the goods.

An individual advertisement must do four things:—(1) Arouse interest; (2) convince the reader; (3) arouse desire; and (4) induce immediate action.

Truth in Advertising.

Earlier in this series the statement has been repeated that writing is primarily the expression of a state of mind. Advertisement writing is no exception to this rule, and the state of mind most conducive to the writing of good advertisements is sincerity. There has been a good deal of newspaper babble about "truth in advertising"; it is one of those phrases easy to use and popular, but lacking genuine "guts." The statements in any advertisement may be perfectly true, but the whole advertisement may be a lie, simply because it omits certain details that would alter the opinion of the potential customer if he knew them. A manufacturer may boast in his announcements that he makes certain parts of hard steel, but if he does not also tell one that certain other parts are made of putty (or of a metal that is little better and nearly as cheap) he cannot claim that his advertising is "truthful." Again, when a gramophone maker claims "perfect reproduction" for his machine, every musician knows he is lying; but for practical purposes his statement is true enough. In short, no one can yet say exactly where truth in advertising begins and where it ends, which is why the phrase "truth in advertising" as a slogan is so much impracticable nonsense.

This does not mean that advertisements are necessarily mendacious, nor that the ideal of truthful advertising is false or impracticable. It is the stupid bawling of a phrase before its implications have been thought out that is here impeached. Before one can make every advertisement writer a fervent advocate of truth in advertising, it is necessary to define the sort of truth you desire and what you mean by truth; how you are going to help a man who refuses to tell a lie and is dismissed for it; and how you are going to ascertain the truth or otherwise of the advertisements when published.

The Advertisement-Writer's Task.

In the present state of advertising, the advertisement writer has to remember that he is a paid servant, just as a lawyer is a paid servant. He is paid, in short, to "state a case" for a certain product, as a lawyer states a case for a certain client. His employment for this purpose is due to his ability to state that case better than the maker of the product himself can, and he can state it better because of his knowledge of advertising technique, of good English, and of the people to whom he is addressing his advertisements. The advertising man is paid not by the public (in which latter case he would be justified in telling every single fact about the product, good, bad or indifferent), but by the manufacturer. It is, therefore, by no means his business to tell the world all or any of the product's bad points. His business is to tell the good points. And he can, and should, do this to the very best of his ability.

What he must not do, and what every conscientious advertisement writer, if he respects his profession, will refuse to do, is to write what is demonstrably untrue about the product, or what he himself knows to be untrue. If he states that a product possesses a certain good point which it does not possess, then he is not only degrading his profession, which is, in its way, a branch of letters, but he is also degrading himself. What is more, the absence of conviction will inevitably—a secret that none can explain—manifest itself in his writing. His advertisements will lack force and sincerity, because they will not spring from certainty and belief. They may temporarily succeed in deluding their public, but it will not be for long.

Knowledge of the Product.

Nothing is better for the advertisement writer than a thorough knowledge of the product he is advertising, followed by a belief in its value, based on personal experience. The advertisement writer should examine the product rigorously, systematically and exactly. It is not enough to look at it, hear what manufacturer and salesman have to say about it, and study the opinion of actual users. All of these have a knack of judging the product by its superficial aspects. It is for the advertising man himself to go more deeply into the matter. The way in which it is suggested he should approach this rigorous analysis is by a detailed classification of questions under the following four main headings:—Appearance, strength, composition and value.

Each of these main headings should be divided into sections in order to show the line of attack, and these sections sub-divided again into as long a list as possible of particular queries. To take but one example, "Value." This main heading should be divided into five departments —"selling price," "wages," "cost," "special terms" and "profits." In each of these departments definite questions arise, which should be tabulated as follow:—

Selling Price.—To user? To merchant? To agent? To branch office? To retailer? In relation to cost? In relation to competition? In relation to purpose? How made up?

Wages.—In relation to selling price? In relation to cost?

Cost.—How made up? In relation to other factors? In relation to profits? Extra charges?

Special Terms.—Reduction in price for quantity offers? Discounts for special users? Guarantees? Replacement terms? After-service? Insurance? Packing?

Profits.—In relation to selling price? On individual articles? On bulk articles?

Exhaustive Study of Product Essential.

This table does not claim to be exhaustive, but it does set out clearly the scope of the advertisement-writer's inquiry. If the other classifications—appearance, strength and composition—are analysed in a similar way, the wide possibilities of striking a really big idea will be increased. It is impossible to believe that an inquiry so minute will fail to reveal many hitherto unperceived selling points and copy angles. These numerous questions must not be confused with market analysis. They represent merely the analysis of the product essential to sound advertisement writing. Another thing that needs emphasis is the necessity for taking each section of the inquiry on its merits, ignoring what may at first sight seem its triviality.

For example, a maker of silverware took great pains to produce a teapot of beautiful design. When the first specimen reached him, he was so annoyed by the discovery of a flaw in the work that in a rage he hurled the teapot at the wall of his office. Picking it up again, he found it was not even dented. This led him to investigate, and he found that his silverware was much tougher than he had ever known, owing to certain qualities in the raw materials. He advertised the fact, and made much money.

One never knows when a seemingly trivial question may reveal an advantage. Tripping up over a piece of curled-up linoleum, for example, led to the invention of Congoleum Gold Seal, which does not kick up at the corners.

Need for Personal Inquiry.

The advertisement writer must, as indicated, make this inquiry a personal one. He must find the answers to the questions himself. Let him take the product and do every diabolical thing he can think of, from jumping on it to hitting it with a hammer. Only thus can he see what it will stand and what it will not. He must not let manufacturers or their staff evade his questions or fob him off with vague answers. And sometimes, in order to do his work thoroughly, he will have to act on the same principle as the doctor who gauges the condition of a limb by comparing it with a known sound one. In other words, he will have to take the competitor's product and submit it to the same stringent inquiry in order to mark the points of difference.

(*To be continued.*)

Hadfields, Limited, at the Buenos Aires Exhibition.—Messrs. Hadfields, Limited, of Sheffield, have two Stands at the British Empire Trade Exhibition, Buenos Aires, which are being run in copartnership with their Buenos Aires agents, Messrs. Anderson, Paterson & Company. The exhibits consist of examples of their crushing machines and accessories. There are also examples of tramway and railway trackwork, and dredging machinery components, in their "ERA" manganese steel. Other exhibits shown include stainless and heat- and corrosion-resisting steels. A portable crushing and screening plant of a new design is being exhibited for the first time. It has been specially designed to meet conditions existing in the Argentine and other South American markets. It is built specially for the use of road-makers and repairers, and consists of two units on separate wheel carriages to facilitate transport. One of these carries a Hadfield steel-frame stone breaker, and the other, a steel structure that supports the screen elevator and discharging hoppers. There is also an historical exhibit illustrating some of the important discoveries made by Sir Robert Hadfield, Bt., F.R.S., the chairman of the company. This exhibit includes a specimen from one of the ingots, also a small casting, made in the year 1882, and forming part of his original researches on alloys of iron and manganese.

Trade Talk.

The South Staffordshire Ironmasters' Association has altered the date of the Birmingham quarterly meeting from April 9 to April 16.

The steamer "Autocarrier," built by Messrs. D. & W. Henderson, Limited, Partick, for the Southern Railway Company for fast cross-Channel traffic, has completed successful trials.

The vessel "Triona," built by Messrs. Harland & Wolff, Limited, Govan, and engined by Messrs. J. G. Kincaid & Company, Limited, Greenock, has been taken over by her owners, the British Phosphate Commissioners.

H. Tollemache & Company, of Canada House, Norfolk Street, London, have received an order from Messrs. Selection Trust, Limited, for pulverised-fuel plant for the operation of the copper-smelting and refining plant at their Roan Antelope Mines in Rhodesia.

The Great Western Railway Company has allocated orders for 62,000 steel sleepers among the following firms:—Guest, Keen & Nettlefolds, Limited; United Steel Companies, Limited; Dorman, Long & Company, Limited; and Ebbw Vale Steel Iron & Coal Company, Limited.

The working shift in the ironworks department of the Dalzell Works of Messrs. Colvilles, Limited, Motherwell, has been extended from 8 hrs. to 9½ hrs., about 160 men being affected. The extension has entailed a modification of rates, and temporary rates have been fixed as affording a basis of discussion between the employers and the men.

The Darlington Rolling Mills Company, Limited, has decided to build another rolling mill at Rise Carr, Darlington. The firm is controlled jointly by Messrs. Dorman, Long & Company, Limited, and the Crittall Manufacturing Company, Limited, and some 18 months ago a special mill was laid down for the accurate rolling of light steel sections.

Employees of Messrs. John G. Stein & Company, Limited, Castlecary Works, Bonnybridge, were entertained by the firm in the Bonnybridge Public Hall on March 27. Colonel Alan Stein, M.C., chairman of the company, presided, and after dinner gave an interesting address on the trade outlook in general and a *résumé* of the firm's activities during the past year. A musical programme and dancing occupied the remainder of the evening.

A new synthetic resin finish, manufactured by Nobel Chemical Finishes, Limited, a subsidiary company of Imperial Chemical Industries, Limited, is claimed to represent the biggest advance in the manufacture of finishes since the introduction of cellulose. Manufacturers have for a long time been undertaking extensive experimental and research work into the production of a new material which would replace the existing stoving enamels and other oil finishes, which have changed little in many years. Nobel Chemical Finishes, Limited, claim to have produced such a material in "Dulux."

The cover of a pamphlet issued by the British Steelwork Association bears an illustration of one of the four symbolic groups of statuary produced by Mr. C. S. Jagger for Imperial Chemical House, London. The group shows a workman hoisting up a steel girder, which in turn upholds buildings of every kind. It is pointed out in the pamphlet that the dominating figure of the workman is a reminder of the close association of labour with the great basic industry of steel, for not only does steel concern the workmen in the steel industry itself, but also those in other branches of industry. One ton of steel requires 3½ tons of coal in the course of its manufacture, and involves the transport of 7 tons of raw material.

A meeting of South Wales business men engaged in leading industries was held at the Swansea Metal Exchange on March 24 to consider the industrial and economic condition of the country. Mr. Frank Rees, J.P. (Llanelly Steel Company, Limited), President of the Exchange, presided. Mr. H. C. Bond, President of the Welsh Sheet and Tinplate Makers' Association, moved a resolution urging that immediate steps must be taken to protect home industries, that action should be taken without delay to design a fiscal system in consultation with the Dominions, for the mutual advantage of Great Britain and the Empire overseas; and that drastic economy and retrenchment in national and local expenditure are urgent and vital elements of any policy effectively designed to bring industry back to prosperity. Mr. Bond said we should continue to suffer unless the nation made a determined and successful effort to change the conditions under which our industries were working. Mr. L. D. Whitehead (Whitehead Iron & Steel Company, Limited) seconded, and the resolution was carried. It was also decided that a South Wales Council of Industry and Commerce be formed, to be affiliated to the National Council of Industry and Commerce.

Reports and Dividends.

John Baker & Bessemer, Limited.—Profit, £24,277; brought in, £14,495; dividend of 4 per cent. on the ordinary shares; carried forward, £20,087.

Sir William Arrol & Company, Limited.—Profit, £62,895; brought in, £20,170; dividend on the ordinary shares of 10 per cent.; to reserve, £30,000; carried forward, £20,540.

P. & W. MacLellan, Limited.—Profit for 1930 of £4,879, but after paying debenture interest there was a loss of £1,871, which reduces the amount to be carried forward to £873.

Cammell Laird & Company, Limited.—Net profit, £28,083; brought in, £15,806, making an available balance of £43,889, which is carried forward, no dividend being recommended on the preference or ordinary shares.

Scottish Tube Company, Limited.—Net profit, £48,226; brought in, £8,173; depreciation, £15,000; reserve, £10,000; preference dividend, £15,000; dividend on the ordinary shares of 2½ per cent., £8,089; carried forward, £8,310.

Vickers-Armstrongs, Limited.—Profit of £337,407, from which the "A" preference dividend for the year to December 31, 1928, is deducted, amounting to £319,215. The balance of £18,192 is added to the carry-forward, making it £60,416.

Vickers, Limited.—Gross profit, £1,173,268; brought in, £228,794; income-tax, £212,870; interest charges, £172,500; directors' fees, £11,473; net profit, £775,926; preference dividends, £418,190; to reserve, £100,000; ordinary dividend of 8 per cent., £254,520; carried forward, £231,970.

Lancashire Steel Corporation, Limited.—Credit £47,937; stock reserve, £16,000; balance of profit, after provision for directors' fees, interest payable and for income-tax, £19,566. The profit resulting from the operations from January 1 to August 1, 1930, has been used to write off a portion of the preliminary and formation expenses, leaving a balance of £3,913 to be carried forward.

Stewarts & Lloyds, Limited.—Profit, £590,645; brought in, £125,496; depreciation, £200,000; interim dividends of 3 per cent. on the preference shares and 5 per cent. on the preferred ordinary shares, £45,725; to income-tax reserve, £50,000; to reserve fund, £100,000; final dividends of 3 and 5 per cent. respectively on the preference and preferred ordinary shares; dividend of 9d. per share on the deferred shares; carried forward, £134,206.

Personal.

Mr. Bradley Stoughton, who has been Professor of Metallurgy at the Lehigh University since 1923, has become consulting metallurgist to the Standard Steel Works Company, Burnham, Pa., U.S.A.

Mr. E. Graham, works manager of the Furness Shipbuilding Company, Limited, Haverton Hill-on-Tees, has been appointed general manager of Irvines Shipbuilding & Dry Dock Company (1930), Limited, Hartlepool.

Mr. Alan D. Maclean has relinquished his position as director of sales and special director of International Combustion, Limited, and joined Messrs. Jenkins Bros. (Birkenhead), Limited, engineers and tankbuilders, as a director resident in London.

Obituary.

Mr. H. F. Parsons, for 25 years manager of the estimating and purchasing department of Messrs. R. & W. Hawthorn, Leslie & Company, Limited, Hebburn-on-Tyne, died on Sunday, March 22, aged 65.

Mr. Peter Gillespie, works manager of Messrs. Mitchell, Russell & Company, Limited, Chattan Foundry, Bonnybridge, died at his home on March 20. He underwent an operation about 18 months ago, from the effects of which he never completely recovered.

Company Meetings.

Scottish Iron & Steel Company, Limited.—Presiding at the annual meeting of the Scottish Iron & Steel Company, Limited, Mr. William Downs (the chairman) said that the capital of the company had been increased to £780,000 by the creation of 30,000 additional ordinary shares. Further, the special reserve fund, which would only be used for making up any deficiency of dividend on the preference shares, had been increased to the full amount agreed upon—£50,000. In addition to the depreciation account at £80,000, the reserves were also £80,000, and the liquid assets were about £200,000. These reflected the strength and soundness of their position. Last year they passed through a trying and difficult time. Taking all the circumstances into account they had done not too badly, and it was comparatively satisfactory that they were able to pay their preference dividend out of profits, leaving intact the special reserve fund of £50,000 already referred to. So far the current year's trading had not promised too favourably, but, if the volume of work should happen to increase somewhat as the year progressed, they were in an excellent position to profit by such an increase.

James Booth & Company (1915), Limited.—The annual meeting of Messrs. James Booth & Company (1915), Limited, was held on March 20 at Birmingham. Mr. C. Herbert Smith (chairman), who presided, said that the net profit for the year was £54,237, as compared with £70,323 for the previous year, when the profits were the highest in the company's history. While there was natural regret at a decrease in profits after a long series of increases, they were bound to recognise the effects arising not only from the decrease in volume in the general business of the country during the year, but also from the special difficulty which confronted their particular industry in the rapid and extraordinary fall in the prices of their main raw materials. The major part of their business was in the manufacture of brass and copper in various forms, and the violent fluctuations in the prices of their raw materials had affected their profits. On the other hand, the increasing strength and efficiency of the business had again evidenced itself in the fact that their mills had been kept fully occupied during the whole of the year, with a total tonnage output in excess of that of the previous year, although the intensified competition which naturally resulted from general depression in trade had an adverse effect on the margin of profit it was possible to obtain. A consistent demand continued for their light aluminium alloy "Duralumin." During the last two years they had taken a prominent part in research and investigation in connection with the production of other light aluminium alloys, and they were now in a position to supply aluminium alloys of even higher strength than those previously in use. They had recently concluded an agreement with the I.G. Farbenindustrie, which gave to them the sole rights in the United Kingdom for the manufacture and sale of "Elektron" in all wrought forms. This magnesium alloy was attracting much attention in many fields of engineering. They were already producing extruded parts in this material, and their equipment for rolling sheets was virtually complete.

New Companies.

Victor Castings, Limited.—Capital £2,000. Iron founders, etc. Directors: J. W. Richards, 109, Dudley Road, Tipton, Staffs.; J. Richards and J. E. Marklew.

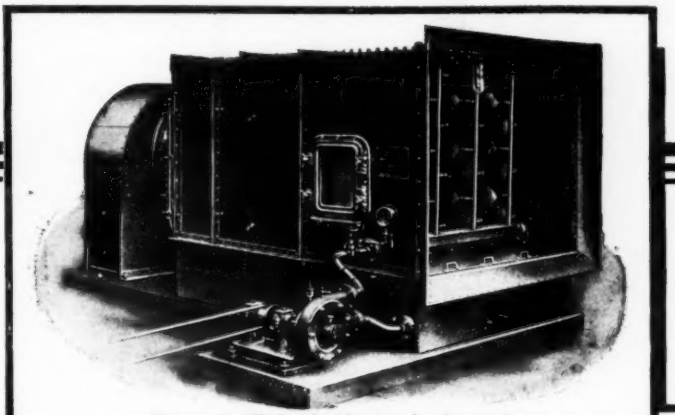
Furnace-Bars, Limited, 4, Half Moon Street, Piccadilly, London, W.—Capital £1,000. Iron, brass and aluminium founders, etc. Directors: E. R. and E. Daniels and D. E. Rodwell.

Robert MacLaren & Company, Limited.—Capital £10,000. Manufacturers of pipes, tubes, boilers, etc. Solicitors: McGrigor, Donald & Company, 172, St. Vincent Street, Glasgow.

Skilled Inspection.—Electrical equipment requires frequent inspection for best operation. The inspections are greatly augmented when the electrical department takes care of most of the starting and stopping of motors.

TRADE SIROCCO MARK

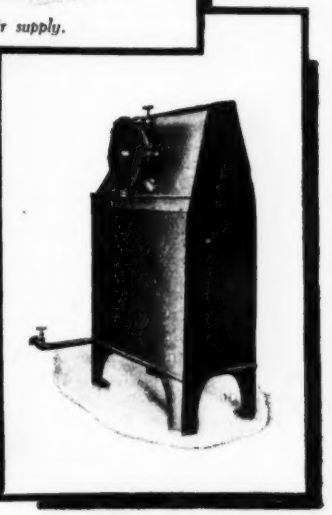
HEATING and VENTILATING EQUIPMENTS



Sirocco Air Washer for cleaning the Air supply.

Central Heating Plants on the hot air principle for large or small buildings, providing an ample supply of pure fresh air at any desired temperature.

Steam Turbine Heater Units in which the steam driving the Fan heats the air supply. A simple and effective method of supplementing an insufficient heating plant. Send for Catalogue No. 8.



DAVIDSON & CO., LIMITED,

Sirocco Engineering Works —— Belfast.

LONDON, GLASGOW, CARDIFF, BRISTOL, MANCHESTER, BIRMINGHAM, NEWCASTLE.

Obtain Your Sand Blast Replacements

FROM

THE FIRM

Who Specialise in the Supply of every Type of Sand Blasting Equipment, the Firm who Invented and first Developed the Process.

If they don't know anything about it—Who Does?

Chilled Iron Shot—Crushed or round. Rubber Gloves. Rubber Blast Hose.
Nozzles. Equipment for Operators. Exhaust Fans. Flint and Sand.
Etc., Etc.

— PROMPT DESPATCH —

WE ARE ALSO MAKERS OF AIR COMPRESSORS & DUST ARRESTERS.

TILGHMAN'S

Telegrams: *"Tilghman's Altrincham."*

PATENT SAND BLAST Co. Ltd.

BROADHEATH, Nr. MANCHESTER.

Telephone: *Altrincham 540.*

SB/121230. H.D.

Iron and Steel Markets.

Pig-Iron.

MIDDLESBROUGH.—It would take a very keen eye to distinguish any improvement in the trade of this district. Except in strike periods, deliveries to Scotland have rarely been so low, and makers are almost entirely dependent on local and inland orders for the disposal of their output. In the Scottish market they are being undersold by Continental and even Indian producers. Shipments from the Tees are, if anything, worse than ever, and Cleveland iron is making no headway whatever in Continental markets. Clearly some external impetus is needed to start a buying movement, but whence this is to come it is difficult to foresee. Consumers entertain no apprehensions about a rise in prices, and, although the producers affirm that present figures leave no margin of profit, some are still hoping for further cuts. The fact is that consumers are experiencing such a limited demand for their own products that they need only very much reduced quantities of iron, and see no reason why they should commit themselves to the purchase of iron which they may not require. Special prices are still quoted for Scottish orders, but for all other destinations the fixed prices are unchanged, the standard No. 3 Cleveland G.M.B. being at 58s. 6d. per ton, No. 1 foundry iron 61s., No. 4 foundry iron 57s. 6d. and No. 4 forge iron 57s. per ton.

Hematite business is largely confined to small parcels for early delivery. Makers report that they are able to realise 67s. 6d. per ton for small parcels of mixed numbers, but much lower prices have been accepted by merchants. Sellers, however, are not prepared to book forward contracts at these depressed prices. The view is taken that ore and coke prices are not likely to continue indefinitely at such low levels, and that only a very slightly increased demand would give an upward trend to the value of raw materials. Therefore, at least 6d. per ton premium is quoted for forward deliveries of East Coast hematite. Bessemer mixed numbers in the North-West of England are firmly quoted at 68s. per ton at works.

LANCASHIRE.—A quiet time is anticipated in this market until after the Easter holiday. The depression of the textile-machinery trade in Lancashire is unfortunately unrelieved, and a normally big local outlet for pig-iron is consequently restricted. In one or two other directions, however, slightly better conditions are reported at the foundries, and there is a slight improvement in the aggregate tonnages going into consumption in this district. Derbyshire and Staffordshire brands of Midland iron are still at 69s. 6d. per ton for delivery to users in the Manchester price zone, with forge iron at 64s. 6d. and Northamptonshire foundry at 68s. North-East Coast iron is in quiet demand on the same price basis as Derbyshire. West Coast hematite iron has maintained a fairly steady position at around 82s. 6d. per ton, delivered equal to Manchester, but there has been an easier tendency in the case of Scottish No. 3, for which current offers range from 89s. to 90s. per ton, delivered Manchester.

MIDLANDS.—No improvement is expected in the demand for foundry pig-iron in this district until some time at least has elapsed after the Easter holiday. Makers of all types of castings are poorly engaged. There is little activity in the case of forge pig-iron, and stocks are accumulating. Buying in the hematite market is solely confined to comparatively small lots for early consumption. The prices quoted by the furnaces for delivery to Birmingham and Black Country stations are 67s. 6d. for Northants No. 3 and 71s. for Derbyshire, North Staffordshire and Lincolnshire No. 3.

SCOTLAND.—No development can be reported in the position of pig-iron in this area. There is a general shortage of orders, what demand there is being mainly for small quantities for immediate delivery. Scottish foundry iron is at 73s. 6d. per ton, f.o.t. furnaces, with a minimum of 2s. 6d. per ton extra for No. 1. For Middlesbrough iron there is little demand. Continental No. 3 can be obtained at 53s. f.o.t. Grangemouth, and Middlesbrough No. 3 at 60s.

Finished Iron.

This market is mainly quiet. No improvement on the conditions of last week can be reported. Makers of Staffordshire marked bars could handle considerably more work than is at present forthcoming at the price of £12 10s. at works. Mills engaged on crown and nut and bolt iron are operating spasmodically. Prices fluctuate considerably. For crown iron £9 5s. is quoted, and current quotations are at anything from this level up to £10. Nut and bolt bars are at £8 12s. 6d. to £8 15s. Only odd orders for bars are placed with British mills, as the bulk of the supplies for the common bolt and nut trade is obtained from the Continent, where the ruling rates are very low.

Steel.

There is no sign of an immediate improvement in trade in steel sections, joists and plates. The arrangement of rolling programmes remains a continual source of anxiety to works managers. There is still only a poor demand for semi-finished steel. Continental prices, while unchanged, are reported to be more firmly quoted, but there is no expansion in the volume of business placed. The British makers' quotations seem to be capable of some shading when a substantial order is offered. The depressed conditions of the galvanised-sheet trade are in no way improved, and substantial orders are still very scarce.

Scrap.

A depression such as at present exists has rarely before been felt so seriously in the iron and steel scrap market of the Cleveland area. The big consumers refuse to buy at any price. The quotation for ordinary-quality cast-iron scrap is 47s. 6d., while good machinery quality might realise 49s. The scrap market in the Midlands is still very quiet. The price of good heavy machinery cast-iron scrap in cupola sizes is 55s. to 57s. 6d., and light cast iron is worth 37s. 6d. Prices in the Scottish market are low. Buyers refuse to buy ahead, as orders for new material are scarce. First-class machinery metal, in pieces not exceeding 1 cwt., is quoted at 52s. 6d., while ordinary cast-iron scrap to the same specification is at 48s. 6d. The above prices are all delivered consumers' works.

Metals.

Copper.—For some time past the copper market has been irregular, and the events of the past week show that some producers are very much opposed to the 10-c. price for domestic consumers in the United States. Consumers, however, are unwilling to pay more than this price, and are holding off the market when a higher rate is asked. There is not much improvement in the general rate of copper consumption in this country, and reports from Germany indicate that there is not much more activity in that country either.

Closing quotations :—

Cash.—Thursday, £43 10s. to £43 11s. 3d.; Friday, £43 1s. 3d. to £43 2s. 6d.; Monday, £43 1s. 3d. to £43 2s. 6d.; Tuesday, £42 18s. 9d. to £43 1s. 3d.

Three Months.—Thursday, £44 2s. 6d. to £44 5s.; Friday, £43 15s. to £43 16s. 3d.; Monday, £43 15s. to £43 16s. 3d.; Tuesday, £43 12s. 6d. to £43 13s. 9d.

Tin.—The tin market is quiet. The quota scheme seems to have made little impression on the minds of consumers so far. Their purchases are limited, and, with steady sales in the East, standard has eased a little. Consumers' immediate requirements seem to be fairly well covered. The tinplate industry is still quiet, both in America and in this country, whereas normally at this time of the year it should be very busy.

Official closing prices :—

Cash.—Thursday, £121 to £121 2s. 6d.; Friday, £120 7s. 6d. to £120 10s.; Monday, £119 10s. to £119 12s. 6d.; Tuesday, £119 5s. to £119 7s. 6d.

Three Months. — Thursday, £122 10s. to £122 12s. 6d.; Friday, £121 17s. 6d. to £122 2s. 6d.; Monday, £121 to £121 2s. 6d.; Tuesday, £120 15s. to £120 17s. 6d.

Spelter.—The spelter market remains weak. Trade in galvanised goods is almost stagnant, and buying by the brassmakers is indifferent. At the moment there does not seem to be any indication of a change for the better.

Daily fluctuations :—

Ordinary.—Thursday, £11 12s. 6d.; Friday, £11 7s. 6d.; Monday, £11 10s.; Tuesday, £11 12s. 6d.

Lead.—For a long time past rumours have been circulating on the question of curtailment, and it is believed by many that the producers do not agree on the matter. It has been realised for some time that very ample supplies of lead were available and that control was relaxing.

The week's prices have been :—

Soft Foreign (Prompt).—Thursday, £12; Friday, £12 2s. 6d.; Monday, £12 3s. 9d.; Tuesday, £12 1s. 3d.

Students' Corner.

Q.—How do cast metals crystallise when cooling from the liquid to the solid state?

A.—According to Dr. Desch "when a metal is melted and allowed to cool it changes into a solid state by a process similar to the freezing of water, or the crystallisation of salt from a solution. If we do not realise this fact, it is because it is less easy to observe in metals. We can see crystals of ice forming on the top of a pond or puddle, but metals are not transparent and the crystallisation goes on mostly out of sight." The crystals which metals form when they solidify are skeletons which are formed from shoots and branches from many centres, but instead of being perfectly symmetrical they are more or less distorted or one-sided. The crystallisation starts at a number of points and if each skeleton grew equally in all directions, the solid metal would in the end be made up of a number of little solid masses similar in form. This regularity is disturbed because the metal does not cool at an equal rate everywhere.

In an ordinary casting, the metal next to the surface cools first, so that the first crystal centres are formed there, but they can only grow inwards, and the skeletons formed are always elongated in that direction. First a long rod or central rib shoots out from the cooling surface into the mass of liquid metal, then this rod gives off branches sideways, and these again branch until a very complicated skeleton is formed. Such a crystal has a structure rather like a fir tree with its trunk and branches, or in other cases like fronds of a fern. As the metal becomes solid the spaces between the branches are gradually filled up and the structure apparently disappears.

Q.—Can the growth of the crystalline structure be directed or influenced by design or contour of the casting?

A.—To some extent this is possible. As a simple illustration, consider a plain frame casting, 6 ft. sq. by 8 in. deep by 1 in. thick. If this frame were laid out in one long strip, 8 in. wide, it would be 24 ft. long. Taking the ordinary contraction of ⅛ in. per ft., 3 in. of contraction would occur. The design of this casting being a square frame, when cooling takes place there may exist four centres of contraction midway between the four corners; consequently, for two reasons, the casting will have four weak places, that is at each corner. The first reason for weakness is that an ordinary cooling contraction strains each corner, the second reason is that the crystalline structure is in its weakest form at the corners due to boundaries of the crystal growth meeting there. It is undoubtedly due to these reasons that the cracking or fracture at the corners of these castings is so common. If the corners were round instead of square, the crystalline form would be at its strongest, instead of its weakest, structure, and cleavage would be much less likely to occur.

FOUNDRY BOXES

...that speed up production for the Modern Foundry—

One of the greatest improvements you can introduce into your foundry is the STERLING ROLLED STEEL MOULDING BOX . . . . the result is speed and economy all round. Your moulders will put down more moulds per day because of the light and easy handling properties of these boxes.

You will be sure of producing accurate castings because STERLING BOXES maintain their accuracy permanently. Also your moulding costs will be halved—STERLING BOXES stand up to heavy service, anywhere.

Sterling

UP-TO-DATE

MOULDING BOX EQUIPMENT

Save their cost in a few months, and are obviously a sound investment for any foundry.

STERLING FOUNDRY SPECIALTIES LTD.,

WORKS— **BEDFORD.**

LONDON OFFICE:— 13, VICTORIA STREET, S.W.1.

GLASGOW - MANCHESTER - NEWCASTLE-ON-TYNE.

WEEKLY PRICE CURRENT.

COPPER.

	£ s. d.
Standard cash	42 18 9
Three months	43 12 6
Electrolytic	45 10 0
Tough	43 15 0
Best selected	44 5 0
Sheets	77 0 0
India	56 5 0
Wire bars	47 12 6
Do., May	47 12 6
Do., June	47 12 6
Ingot bars	47 12 6
H.C. wire rods	48 10 0
Off. av. cash, February	45 8 3¾
Do., 3 mths., February	45 6 1½
Do., Sttlmnt., February	45 8 1½
Do., Electro, February	48 4 4½
Do., B.S., February	47 5 0
Do., wire bars, February	48 9 9
Solid drawn tubes	11d.
Brazed tubes	11d.
Wire	7d.

BRASS.

Solid drawn tubes	9¾d.
Brazed tubes	11¾d.
Rods, drawn	9¾d.
Rods, extd. or rlld.	5¼d.
Sheets to 10 w.g.	8¼d.
Wire	8¼d.
Rolled metal	7¾d.
Yellow metal rods	5¼d.
Do. 4 × 4 Squares	6d.
Do. 4 × 3 Sheets	6¼d.

TIN.

	£ s. d.
Standard cash	119 5 0
Three months	120 15 0
English	120 5 0
Bars	122 10 0
Straits	122 7 6
Australian	121 0 0
Eastern	123 12 6
Banca	122 10 0
Off. av. cash, February	118 0 0¾
Do., 3 mths., February	119 9 3
Do., Sttlmt., February	118 0 3

SPELTER.

	£ s. d.
Ordinary	11 12 6
Remelted	10 7 6
Hard	9 0 0
Electro 99.9	13 15 0
English	11 17 6
India	10 12 6
Zinc dust	19 10 0
Zinc ashes	2 15 0
Off. aver., February	12 9 11¼
Aver. spot, February	12 6 0¾

LEAD.

	£ s. d.
Soft foreign ppt.	12 1 3
English	13 10 0
Off. average, February	13 9 11½
Average spot, February	13 8 10½

ZINC SHEETS, &c.

	£ s. d.
Zinc sheets, English	21 0 0
Do., V.M. ex-whf.	20 0 0
Rods	23 0 0
Boiler plates	14 0 0
Battery plates	15 15 0

ANTIMONY.

	£ s. d.
Special brand, Eng.	36 0 0
Chinese	25 0 0
Crude	22 0 0

QUICKSILVER.

	£ s. d.
Quicksilver	22 7 6

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—	
25%	£7 10 0
45/50%	£10 10 0
75%	£17 0 0
Ferro-vanadium—	
35/50%	12/8 lb. Va.
Ferro-molybdenum—	
70/75% c. free	4/2 lb. Mo.
Ferro-titanium—	
23/25% carbon-free	9d. lb.
Ferro-phosphorus, 20/25%	£15 15 0
Ferro-tungsten—	
80/85%	2/- lb.
Tungsten metal powder—	
98/99%	2/3 lb.
Ferro-chrome—	
2/4% car.	£29 0 0
4/6% car.	£21 0 0
6/8% car.	£19 17 6
8/10% car.	£19 12 6
Ferro-chrome—	
Max. 2% car.	£30 10 0
Max. 1% car.	£34 0 0
Max. 0.70% car.	£36 5 0
70% carbon-free	10d. lb.
Nickel—99% £170 0 0 to £175 0 0	
Ferro-cobalt	9/3 lb.
Aluminium 98/99%	£85 0 0
Metallic chromium—	
96/98%	2/7 lb.
Ferro-manganese (net)—	
76/80% loose	£11 0 0
76/80% packed	£12 0 0
76/80% export	£ 9 0 0
Metallic manganese—	
94/96% carbonless	1/3 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	£0 2 0
Finished bars, 18% tungsten	£0 2 9

Per lb. net, d/d buyers' works.

Extras—	
Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to $\frac{3}{16}$ in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅛ in.	3d. lb.
Do., under ½ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP.

South Wales	£ s. d.	£ s. d.
Heavy steel		2 7 6
Bundled steel and shrngs.	1 17 6 to	2 2 0
Mixed iron and steel	1 18 0 to	2 1 0
Heavy cast iron	2 8 0 to	2 10 0
Good machinery for foundries		2 12 6
Cleveland—		
Heavy steel		2 5 0
Steel turnings		1 10 0
Cast-iron borings		1 5 0
Heavy forge		2 15 0
W.I. piling scrap		2 11 6
Cast-iron scrap	2 7 6 to	2 9 0
Midlands—		
Light cast-iron scrap		1 17 6
Heavy wrought		2 18 6
Steel turnings		—
Scotland—		
Heavy steel		2 5 0
Ordinary cast iron		2 8 6
Engineers' turnings		1 12 6
Cast-iron borings		1 12 6
Wrought-iron piling		2 15 0
Heavy machinery		2 12 6

London—Merchants' buying prices delivered yard.

	£ s. d.
Copper (clean)	37 0 0
Brass	26 0 0
Lead (less usual draft)	10 0 0
Tea lead	7 0 0
Zinc	6 0 0
New aluminium cuttings	50 0 0
Braziery copper	34 0 0
Gunmetal	35 0 0
Hollow pewter	76 0 0
Shaped black pewter	56 0 0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	61/-
Foundry No. 3	58/6
Foundry No. 4	57/6
Forge No. 4	57/-
Hematite No. 1	68/-
Hematite M/Nos.	67/6
N.W. Coast—	
Hem. M/Nos. d/d Glas.	75/-
„ d/d Birm.	86/6
Malleable iron d/d Birm.	117/6
Midlands—	
Staffs common*	—
„ No. 4 forge*	66/-
„ No. 3 fdry.*	71/-
Shrops basic	—
„ Cold blast, ord.	—
„ „ roll iron	—
Northants forge*	62/6
„ fdry. No. 3*	67/6
„ fdry. No. 1*	70/6
Derbyshire forge*	66/-
„ fdry. No. 3*	71/-
„ fdry. No. 1*	74/-
„ basic*	—

*d/d Black Country dist.

Scotland—	
Foundry No. 1	76/-
„ No. 3	73/6
Hem. M/Nos. d/d	74/-
Sheffield (d/d district)—	
Derby forge	61/-
„ fdry. No. 3	66/-
Lincs forge	—
„ fdry. No. 3	66/-
E.C. hematite	81/6
W.C. hematite	84/6
Lancashire (d/d eq. Man.)—	
Derby forge	64/6
„ fdry. No. 3	69/6
Staffs fdry. No. 3	69/6
Northants fdry. No. 3	68/-
Cleveland fdry. No. 3	69/6
Dalzell, No. 3 (special)	105/- to 107/6
Summerlee, No. 3	89/- to 90/-
Glengarnock, No. 3	—
Eglinton, No. 3	89/- to 90/-
Gartsherrie, No. 3	89/- to 90/-
Monkland, No. 3	89/- to 90/-
Shotts, No. 3	89/- to 90/-

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£ s. d.	£ s. d.
Bars (cr.)	10 0 0 to	10 10 0
Nut and bolt iron	8 12 6 to	8 15 0
Hoops	10 15 0 to	12 0 0
Marked bars (Staffs) f.o.t.		12 10 0
Gas strip	10 15 0 to	12 0 0
Bolts and nuts, ¾ in. × 4 in.		14 5 0
Steel—		
Plates, ship, etc.	8 15 0 to	8 17 6
Boiler plts.	9 5 0 to	10 5 0
Chequer plts.		10 7 6
Angles		8 7 6
Tees		9 7 6
Joists		8 15 0
Rounds and squares, 3 in. to 5½ in.		9 7 6
Rounds under 3 in. to ¾ in. (Untested)	7 2 6 to	7 15 0
Flats—8 in. wide and over		8 12 6
„ under 8 in. and over 5 in.		8 17 6
Rails, heavy	8 5 0 to	8 10 0
Fishplates		12 0 0
Hoops (Staffs)	9 5 0 to	9 10 0
Black sheets, 24g.	8 10 0 to	9 10 0
Galv. cor. shts. 24g.		11 0 0
Galv. flat sheets		11 10 0
Galv. fencing wire, 8g. plain		12 0 0
Billets, soft	5 5 0 to	5 12 6
Billets, hard	7 2 6 & up.	
Sheet bars	5 0 0 to	5 12 6
Tin bars	5 0 0 to	5 12 6

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	11½d.
Sheet to 10 w.g.	1/-
Wire	1/1
Rods	1/-
Tubes	1/7
Castings	1/-

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7½
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round—	
3/- to 10 g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	17.76
No. 2 foundry, Valley	16.50
No. 2 foundry, Birm.	12.00
Basic	18.26
Bessemer	18.76
Malleable	18.76
Grey forge	17.76
Ferro-mang. 80%	80.00
O.-h. rails, h'y, at mill	43.00
Billets	30.00
Sheet bars	30.00
Wire rods	35.00
	Cents.
Iron bars, Phila.	2.09
Steel bars	1.65
Tank plates	1.65
Beams, etc.	1.65
Skelp, grooved steel	1.60
Skelp, sheared steel	1.60
Steel hoops	1.90
Sheets, black, No. 24	2.35
Sheets, galv., No. 24	2.90
Sheets, blue an'l'd, No. 13	2.05
Wire nails	1.90
Plain wire	2.20
Barbed wire, galv.	2.55
Tinplates, 100-lb. box	$5.00

COKE (at ovens).

Welsh foundry	22/6 to 25/-
„ furnace	15/- to 16/-
Durham and Northumberland—	
„ foundry	13/6 to 14/-
„ furnace	13/6
Midlands, foundry	—
„ furnace	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 box	15/3
„	28×20 „	30/6
„	20×10 „	22/3
„	18¾×14 „	16/1½
C.W.	20×14 „	14/3
„	28×20 „	28/6
„	20×10 „	21/-
„	18¾×14 „	15/-
Terneplates	28×20	31/- per box basis f.o.b.

SWEDISH CHARCOAL IRON & STEEL.

Pig-iron	£6 0 0 to £7 10 0
Bars, hammered, basis	£17 10 0 to £18 10 0
Bars and nail-rods, rolled, basis	£15 17 6 to £16 15 0
Blooms	£10 0 0 to £12 0 0
Keg steel	£32 0 0 to £33 0 0
Faggot steel	£20 0 0 to £24 0 0
Bars and rods dead soft, st'l	£11 0 0 to £14 0 0

All per English ton, f.o.b. Gothenburg.

TUBES AND FITTINGS.

Over ⅛ in. up to 6 in.

	Tubes.	*Fittings.*
Gas	62½%	47½%
Water ..	58½%	42½%
Steam ..	55%	37½%

W.I. 12½% extra.

DAILY FLUCTUATIONS.

Standard Copper (cash).

			£	s.	d.		
Mar.	26	..	43	10	0	dec.	6/3
,,	27	..	43	1	3	,,	8/9
,,	30	..	43	1	3	No	change
,,	31	..	42	18	9	dec.	2/6

Electrolytic Copper.

			£	s.	d.		
Mar.	26	..	46	0	0	dec.	10/-
,,	27	..	45	15	0	,,	5/-
,,	30	..	45	15	0	No	change
,,	31	..	45	10	0	dec.	5/-

Standard Tin (cash).

			£	s.	d.		
Mar.	26	..	121	0	0	dec.	10/-
,,	27	..	120	7	6	,,	12/6
,,	30	..	119	10	0	,,	17/6
,,	31	..	119	5	0	,,	5/-

Tin (English ingots).

			£	s.	d.		
Mar.	26	..	122	0	0	dec.	10/-
,,	27	..	121	10	0	,,	10/-
,,	30	..	120	10	0	,,	20/-
,,	31	..	120	5	0	,,	5/-

Zinc Sheets (English).

			£	s.	d.		
Mar.	26	..	21	0	0	No	change
,,	27	..	21	0	0	,,	,,
,,	30	..	21	0	0	,,	,,
,,	31	..	21	0	0	,,	,,

Spelter (ordinary).

			£	s.	d.		
Mar.	26	..	11	12	6	dec.	3/9
,,	27	..	11	7	6	,,	5/-
,,	30	..	11	10	0	inc.	2/6
,,	31	..	11	12	6	,,	2/6

Lead (English).

			£	s.	d.		
Mar.	26	..	13	10	0	dec.	10/-
,,	27	..	13	10	0	No	change
,,	30	..	13	10	0	,,	,,
,,	31	..	13	10	0	,,	,,

AVERAGE MONTHLY PRICES OF STEEL BOILER PLATES IN ENGLAND.

Year.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1895	5 15 0	5 15 0	5 12 6	5 12 6	5 15 0	5 17 6	5 15 0	5 17 6	6 0 0	6 0 0	6 2 6	6 0 0	5 16 10½
1896	6 0 0	6 0 0	6 2 6	6 2 6	6 2 6	6 0 0	6 0 0	6 0 0	6 0 0	6 2 6	6 10 0	6 10 0	6 2 6
1897	6 10 0	6 10 0	6 10 0	6 7 6	6 2 6	6 2 6	6 5 0	6 0 0	6 0 0	6 0 0	6 7 6	6 10 0	6 5 5
1898	6 10 0	6 8 9	6 8 9	6 10 0	6 15 0	6 18 9	6 17 6	6 17 6	7 2 6	8 15 0	7 0 0	7 5 0	6 15 8½
1899	7 5 0	8 0 0	8 2 6	8 2 6	8 5 0	8 5 0	8 12 6	8 12 6	8 15 0	8 15 0	9 2 6	9 5 0	8 17 8½
1900	9 5 0	9 5 0	9 7 6	9 10 0	9 12 6	10 5 0	10 5 0	10 5 0	10 5 0	10 0 0	9 15 0	9 15 0	9 15 10
1901	9 5 0	9 5 0	8 15 0	8 10 0	8 10 0	7 10 0	7 15 0	7 15 0	7 15 0	7 15 0	7 15 0	7 15 0	8 3 11
1902	7 7 6	7 0 0	7 12 6	7 12 6	7 12 6	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 9 7
1903	7 10 0	7 10 0	7 15 0	7 5 0	7 5 0	7 5 0	7 5 0	7 0 0	7 0 0	7 0 0	7 0 0	6 17 6	7 3 11½
1904	6 12 6	6 15 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	6 18 11½
1905	6 17 6	6 17 6	6 17 6	6 17 6	6 17 6	6 17 6	6 17 6	6 17 6	6 10 0	7 5 0	8 0 0	8 0 0	7 1 3
1906	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 10 0	8 0 10
1907	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 0 0	8 0 0	8 8 4
1908	7 10 0	7 10 0	7 10 0	7 5 0	7 5 0	7 5 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 3 9
1909	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	6 15 0	6 15 0	6 15 0	7 0 0	7 0 0	7 0 0	7 0 0	6 18 9
1910	7 0 0	7 0 0	7 1 3	7 5 0	7 5 0	7 5 0	7 5 0	7 5 0	7 5 0	7 10 0	7 10 0	7 10 0	7 5 1
1911	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 14 0	7 10 4
1912	7 18 9	8 0 0	8 0 0	8 7 6	8 10 0	8 10 0	8 10 0	8 15 0	8 16 3	9 0 0	9 2 0	9 5 0	8 11 2½
1913	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	8 19 0	8 15 0	8 5 0	7 15 0	7 15 0	8 17 0
1914	7 15 0	7 15 0	7 15 0	7 13 9	7 10 6	7 5 0	7 0 0	8 0 0	8 2 6	8 5 0	8 5 0	8 5 0	7 15 11½
1915	8 14 0	9 10 0	9 17 6	10 10 0	10 10 0	11 0 0	11 0 0	11 0 0	11 0 0	11 4 0	12 0 0	13 0 0	10 15 5½
1916	13 0 0	13 0 0	13 0 0	12 15 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 12 11
1917	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0
1918	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0
1919	13 0 0	15 0 0	15 0 0	15 0 0	19 5 0	19 17 6	21 0 0	21 10 0	21 10 0	21 10 0	21 15 0	23 10 0	18 9 9
1920	26 0 0	28 0 0	28 5 0	28 10 0	29 5 0	30 0 0	30 0 0	30 0 0	30 10 0	31 0 0	31 0 0	31 0 0	29 9 2
1921	30 5 0	29 0 0	25 0 0	25 0 0	25 0 0	23 0 0	21 0 0	20 10 0	19 0 0	17 10 0	16 0 0	14 16 0	22 1 9
1922	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	13 1 8	13 10 0	12 15 0	12 10 0	12 10 0	12 10 0	12 6 0	13 10 9
1923	12 8 9	13 6 0	14 0 0	14 0 0	14 0 0	14 0 0	13 12 6	13 0 0	13 0 0	13 0 0	13 0 0	13 10 0	13 9 1½
1924	13 10 0	13 10 0	13 10 0	13 10 0	13 10 0	13 10 0	13 10 0	14 0 0	14 0 0	13 11 0	13 5 0	13 5 0	13 10 11
1925	13 5 0	13 5 0	13 5 0	13 1 0	12 15 0	12 15 0	12 15 0	12 15 0	12 7 6	11 14 0	11 10 0	11 10 0	12 11 5½
1926	11 10 0	11 10 0	11 10 0	11 5 0	11 5 0	11 5 0	11 5 0	11 5 0	11 5 0	11 5 0	11 5 0	11 5 0	11 6 3
1927	11 5 0	11 5 0	11 5 0	11 5 0	11 2 6	11 0 0	11 0 0	11 0 0	10 16 0	10 10 0	10 10 0	10 10 0	10 19 0½
1928	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0
1929	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 5 0	10 1 3	10 1 3	10 1 7	10 6 8½
1930	10 2 9	10 3 5½	10 3 9	10 3 9	10 3 6	10 2 6	10 2 6	10 2 6	10 2 2½	9 19 6	9 16 3	9 16 3	10 1 6½
1931	9 15 0	9 15 0	9 15 0	—	—	—	—	—	—	—	—	—	—

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